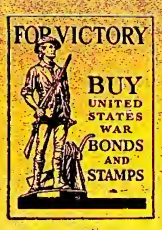
COMMUNICATIONS

RADIO ENGINEERING

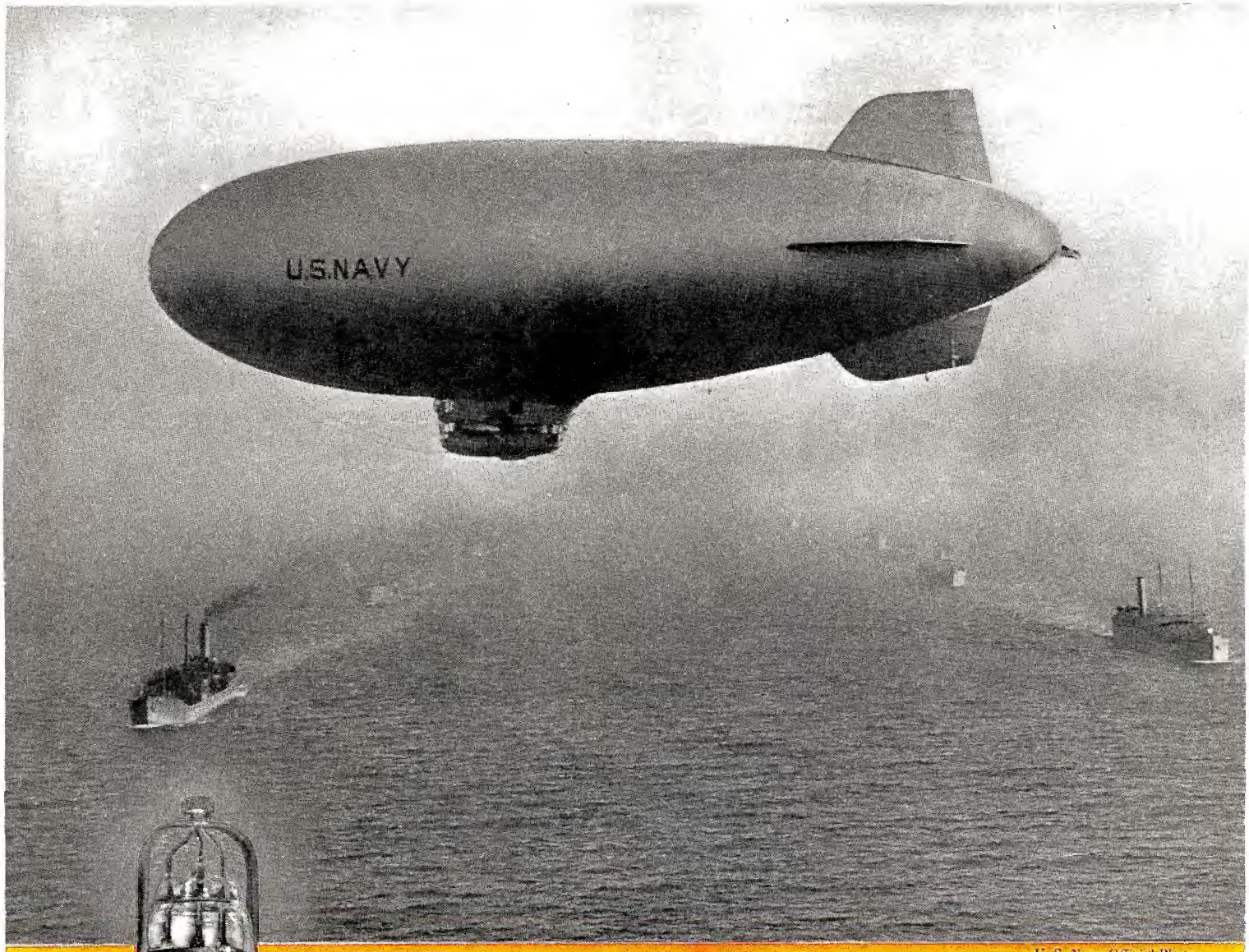
AIRCRAFT U-H-F
TEST OSCILLATOR

A REPORT ON THE
ROCHESTER FALL MEETING

RELAYS IN COMMUNICATIONS



NOVEMBER
1942



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AMPEREX Electronic Tubes are incorporated in vital protective equipment serving an alert convoy system speeding vital materials over vast and dangerous distances.

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Serving the cause of Victory
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The lives of America's fighting men — the winning of America's battles depend on swift, sure radio communications.
Army radio equipment must be completely dependable. Exacting Army specifications make sure it will be.
The Air Corps and Signal Corps test, approve, and use Murdock Radio Phones.
MURDOCK MANUFACTURING COMPANY—Chelsea, Mass.

LEWIS WINNER, Editor
F. WALEN, Associate Editor

We See...

AN UNUSUAL TECHNICIAN TRAINING PROGRAM has just swung into action in Philadelphia. Known as the Philadelphia Local of the American Communications Association training plan, it calls for the training of two classes of personnel. The first class consists of persons who already hold operator's licenses, but with no practical experience in a broadcast station. The second group of trainees are those who have not yet had the theoretical course required for obtaining an operator's license. Qualified applicants who hold licenses are being distributed and routed by the union through the stations in such a manner that each applicant will spend one week in succession at each of eight stations in Philadelphia, assuring actual experience in every variety of station, large and small. There'll be no compensation for this training period. Hours are so arranged so that they do not interfere with the trainees present employment schedule. At the conclusion of the training period, the trainee's record is submitted to the chief engineers of the stations and the union shop stewards in the stations. If approved, he then becomes eligible for employment.

The second group applicants, who are approved by the union, are accepted as students at the Dobbins Vocational School, Philadelphia. Equipment necessary for laboratory work is being provided by the stations and the Board of Education. This course will last for thirteen weeks, five nights a week. If the applicant succeeds in passing the examination at the conclusion of the course, he then proceeds to the eight-week practical training course in the stations.

Our congratulations to the union, stations and Board of Education of Philadelphia for their coordinated spirit in making this fine plan possible!

IT WAS A-1-J LAST MONTH. It will be AA-1 on January 1, 1943, for broadcasting station repairs and replacements. This top-top priority rating was formerly reserved for the Army and Navy only. Who says the WPB didn't appreciate the needs of the *Communications* industry?—L. W.

COMMUNICATIONS

Including Television Engineering, Radio Engineering, Communication & Broadcast Engineering, The Broadcast Engineer. Registered U.S. Patent Office.
Member of Audit Bureau of Circulations.

NOVEMBER, 1942

VOLUME 22 NUMBER 11

COVER ILLUSTRATION

Inserting a tube mount in an anode-envelope assembly in a tube being rebuilt, before sealing, exhaust and basing; one of the many steps involved in tube rebuilding today. See pages 15, 16 and 25, this issue, for a complete analysis of a new and important program of tube rebuilding. *(Courtesy RCA)*

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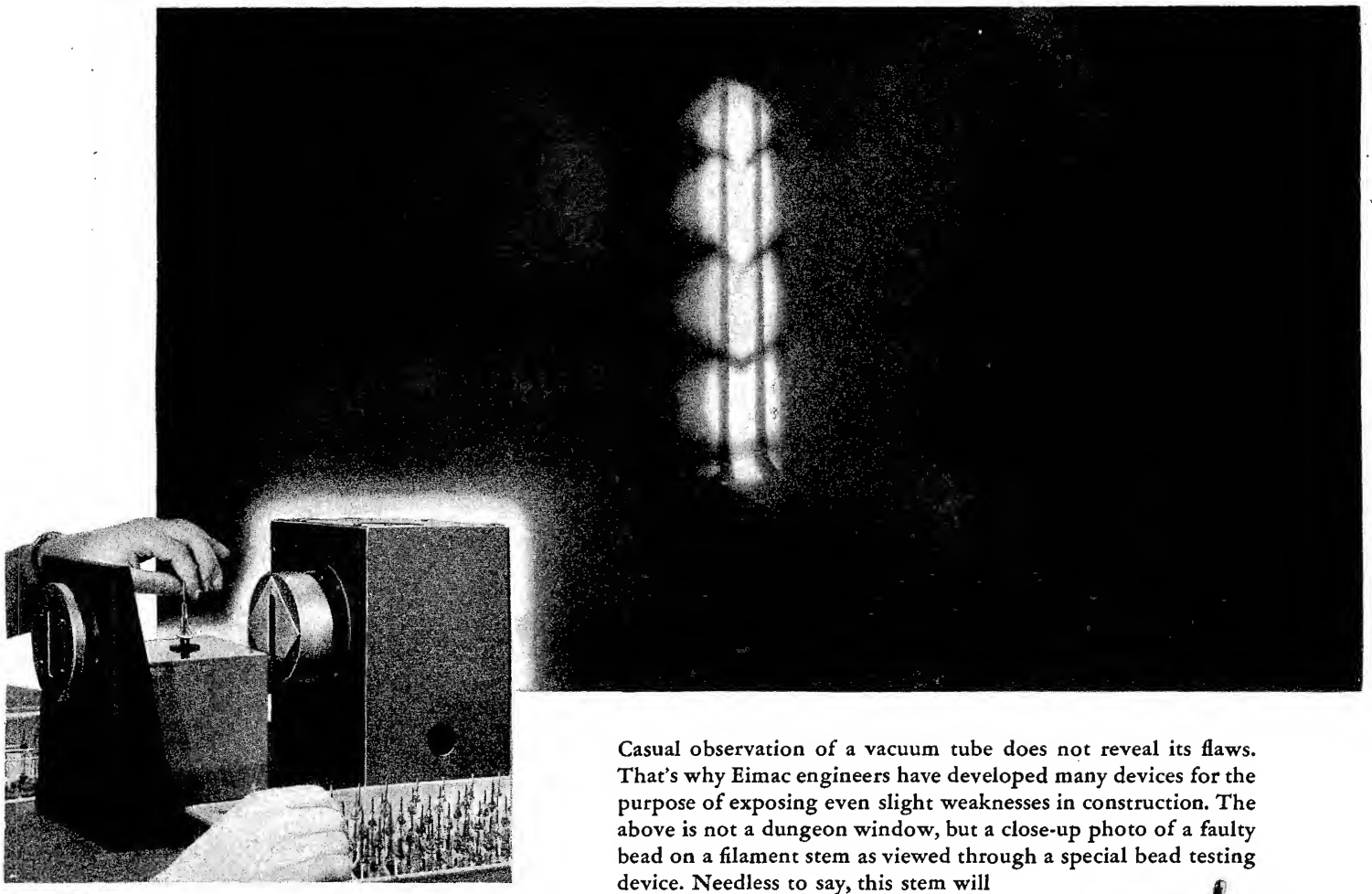
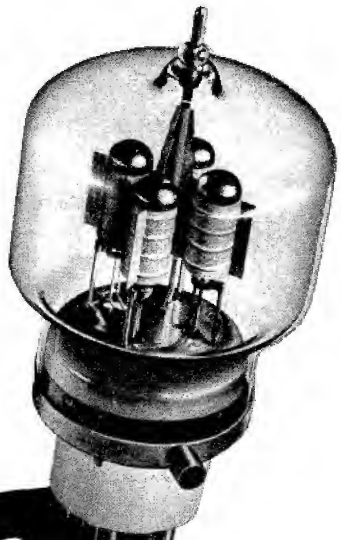
DEATH *before* DISHONOR!



Observation of the stress points on glass bead seals around vacuum tube leads is made with this device. Close-up photo above shows the actual view of a faulty lead. Note the change in polarized light creating distorted shadows which show up stress and strain in beads. Such strain sometimes occurs where metal and glass are sealed together.

Casual observation of a vacuum tube does not reveal its flaws. That's why Eimac engineers have developed many devices for the purpose of exposing even slight weaknesses in construction. The above is not a dungeon window, but a close-up photo of a faulty bead on a filament stem as viewed through a special bead testing device. Needless to say, this stem will never reach final assembly . . . better "death before dishonor" to the Eimac tradition of dependability.

Such care in production plus constant research into the phenomenon of the electron tube assures you of the utmost in performance from every Eimac tube . . . provides the answer to why Eimac tubes are first choice by most of the leading engineers throughout the world.



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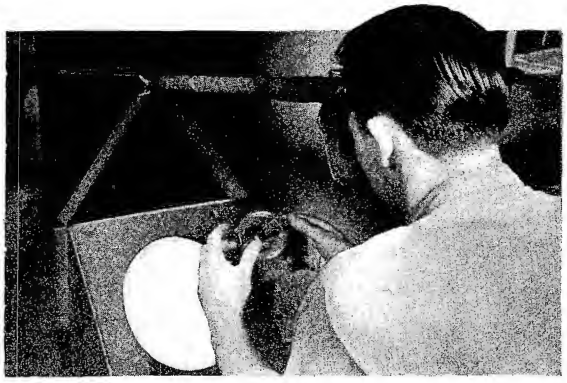

Inspecting the entire glass bulb with the help of a polarized light. This device shows up stress and strain on the glass which might be created during the shaping operations.

Follow the leaders to

Eimac TUBES

FOR VICTORY BUY UNITED STATES SAVINGS BONDS AND STAMPS

Mfg. by Eitel-McCullough, Inc., San Bruno, California, U. S. A.

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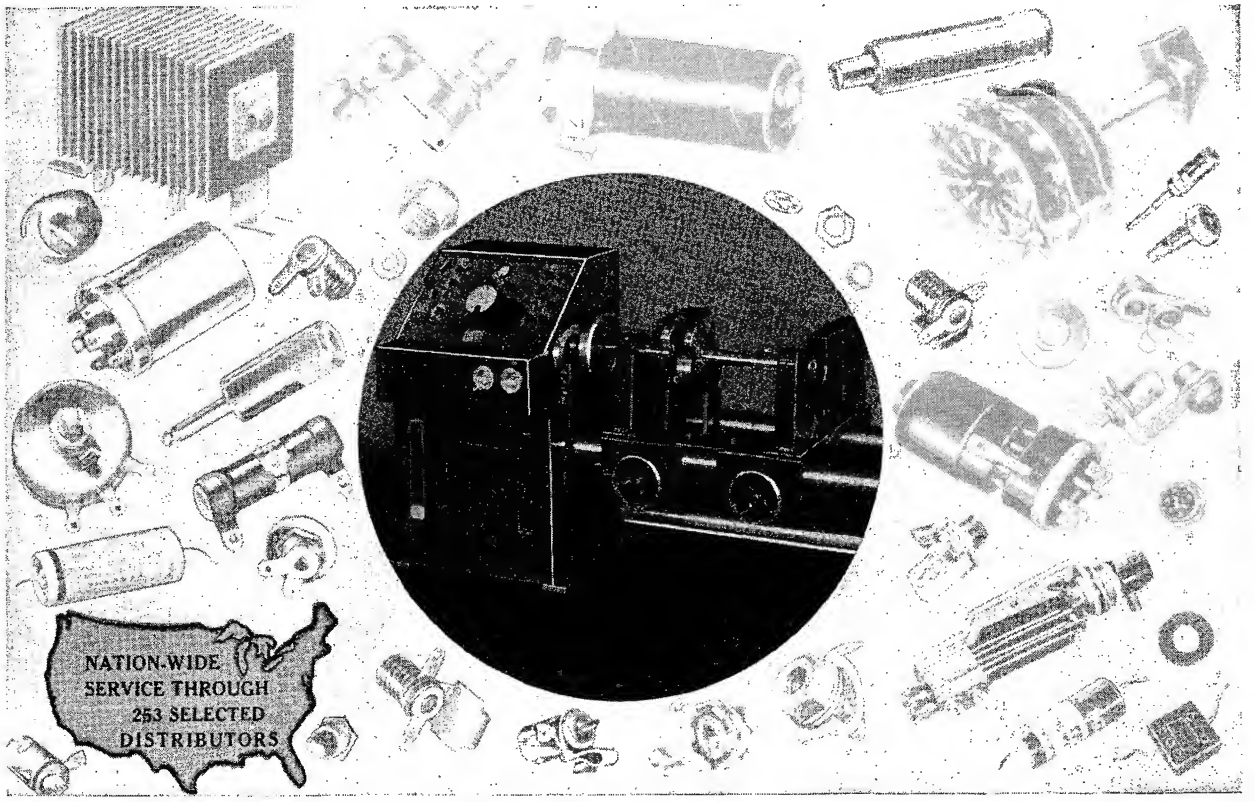

Balancing crankshafts of airplane engines assures longer motor life and less vibration... makes fighter planes easier to handle in the air. Thus many airplane engine manufacturers are using Gisholt Dynetric Balancing Machines to help attain more perfect operation and a smoother flow of power from the multi-horsepower engines they make.

Balancing machines made by Gisholt also improve the performance of many other products... from tiny motor armatures and small ventilating fans to heavy turbine rotors... used in many industries. To control these Dynetric Balancers, ultra-precise electronic parts are needed... such parts as the electrical switches supplied by Mallory.

Similarly, a large manufacturer of aircraft engines for both American and British warplanes utilizes many Dynamometer engine test cells... equipped with standard Mallory jack switches... a Mallory Approved Precision Product obtained in quantity, promptly, through the local Mallory Distributor.

Do you need electronic hardware, condensers, rectifiers, resistors or volume controls? For testing or experimental work? Or perhaps for plane replacements? Or as an integral part of some electrically operated device you plan to manufacture? See your nearest Mallory Distributor.

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An Aircraft Marker Receiver

U-H-F TEST OSCILLATOR

Unique instrument affords complete sky-way service check before the airplane leaves the field

by CHARLES W. McKEE

Supervisor of Aircraft Radio, Eastern Air Lines, Inc.

PRIOR to aircraft departure, it is essential that the airways u-h-f marker receivers be subjected to a thorough test, particularly in an "on-the-air" way. This requires a test oscillator, of special design, that will simulate the actual signal from an airways u-h-f marker transmitter, and thus afford a thorough operational check. In such a test, the associated parts such as the controls, antenna system, indicators, are also checked here, as well as in the shop.

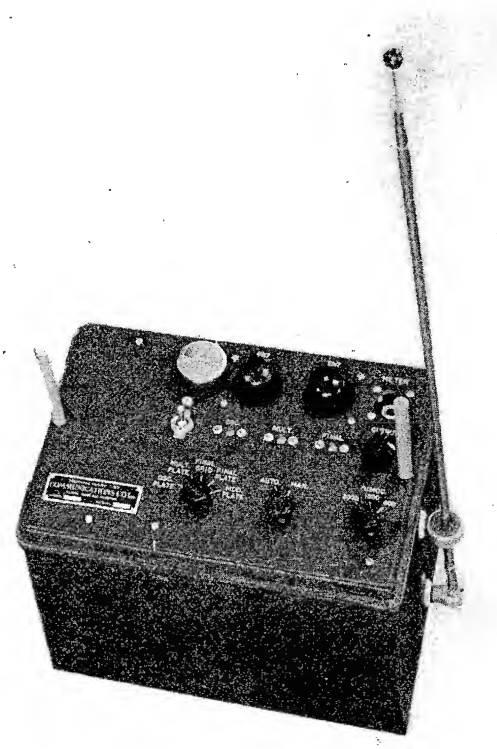
The Installation Test

For the installation test it is essential that this signal source be provided in an "artificial" way, because it is not possible to receive a signal from the marker station when the aircraft is on the ground.

To guide the transport plane along the civil airways the 75 mc marker performs its share of the job with the other radio aids to navigation, such as the radio range (beam) and the radio compass. This marker is employed to convey to the aircraft a "position fix" independent of that given by the radio range and the radio direction finder. Obviously the results are that of a dual-check which is mandatory in this type of work. It is of particular value during adverse weather conditions.

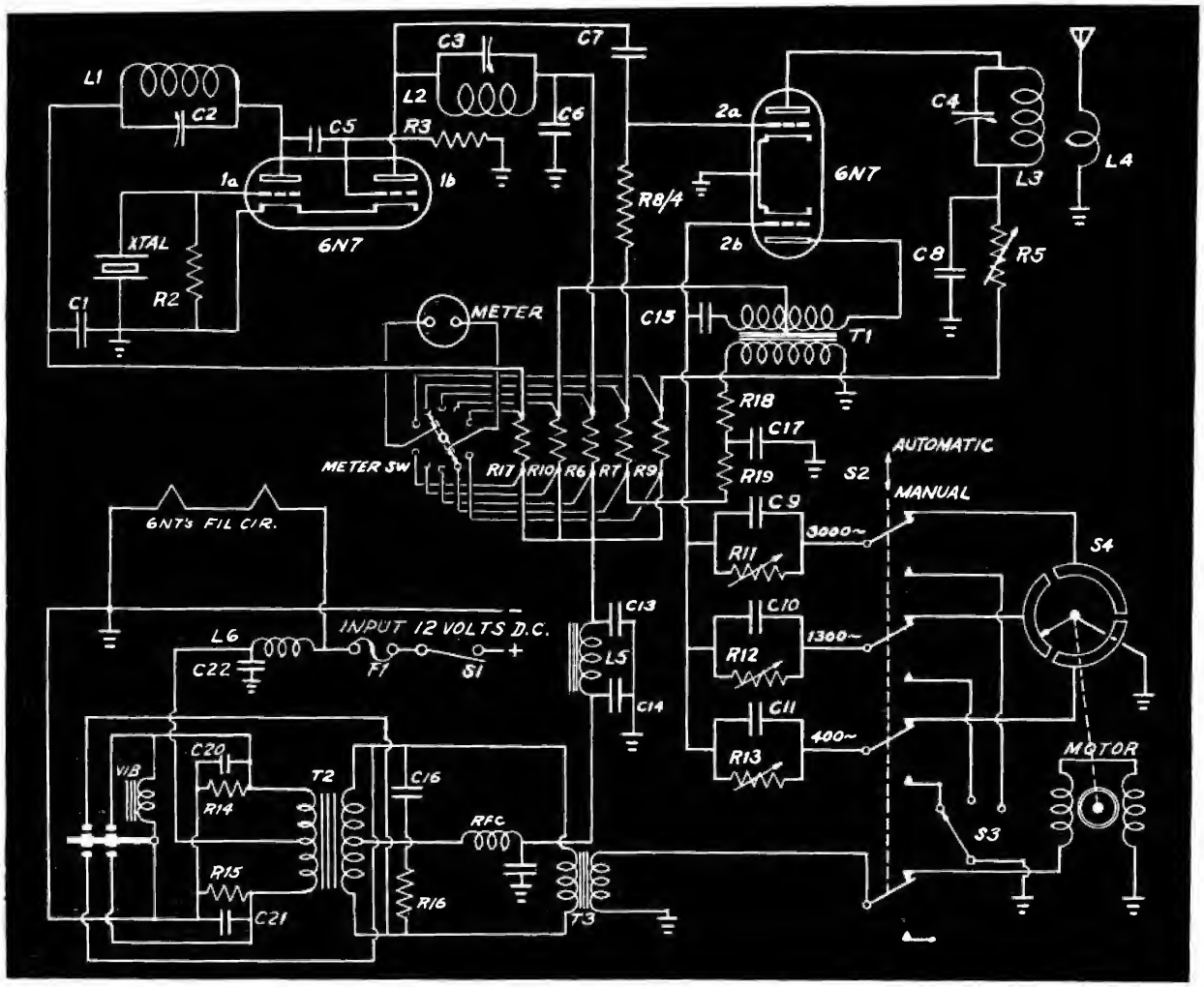
The U-H-F Ground Transmitter

The u-h-f marker transmitter that is located on the ground consists of a generator of a 75 mc carrier with the appropriate modulation system. The antenna design is of a type that projects a vertical beam of comparatively small horizontal area. To utilize this service the aircraft is equipped with a receiver especially designed for the purpose. The functions of the marker receiver are to give an aural signal and a visual signal when the aircraft is above the location of the marker transmitter. Visual signals are given by a unit of three lights that are energized through the audio selector system of the receiver output. Each classification of the marker transmitter stations, namely, "zone and fan" markers and the "approach" markers, are assigned a designating modulation frequency. Thus, the appropriate visual



The u-h-f test oscillator unit that provides a means of checking up on the aircraft marker receiver in a plane, by transmitting a signal equivalent to that sent out by the standard ground transmitter. All of the permanent transmitter transmission characteristics are duplicated with this unit, so that an actual "in-service" test is assured.

(Courtesy Communications Co.)



The circuit diagram of the ultra-high-frequency test oscillator. A 12.5 mc crystal is employed between the grid and cathode of one of the triodes of the 6N7 tube. The oscillator plate of this tube is tuned to the crystal frequency.

indicator (lamp) is operated as a function of the 400 or 1300 or 3000 cps modulation.[1]

A 75 mc Unit

Essentially a test unit of this kind is one that produces a source of 75 mc signal and various types are now in service. The unit described herein was designed under the supervision of the writer, and contains certain design features that makes the unit particularly applicable for the intended service.

Location of Unit During Test

During tests the oscillator test unit is located outside of the aircraft and near the aircraft marker receiver antenna. This condition permits determination of over-all performance of the marker receiver system.

The Circuit

In the circuit a 12.5 mc crystal is connected in a conventional manner between the grid and cathode of one of the triodes (1-a) of the 6N7 tube. The oscillator plate circuit is tuned to the crystal frequency. The other section of this 6N7 (1-b) is the harmonic amplifier in which the plate circuit is tuned to the third harmonic. Another 6N7 tube serves the dual purpose of a final amplifier (2-a) and audio frequency oscillator triode (2-b). The plate circuit of the final amplifier is resonated for the sixth harmonic.

The a-f circuit of the tube (2-b) employs three separate component sections designed to deliver the three desired modulation frequencies. The transformer T-1 is a portion of the audio frequency oscillator and also serves to modulate the grid of the final amplifier (2-a).

The audio frequencies are periodically selected by use of a rotatable switch. This is driven by an a-c motor which secures its power from a vibrator power pack. Because a switch of this type requires very little driving power it is practical to use a simple motor of this type. It requires no brushes; it is ideal from a maintenance viewpoint and from the electrical interference angle.

Plate voltage is provided by the use of a synchronous type vibrator power pack. The high voltage is well filtered as well as the low voltage input. The latter is important because the vibrator hash must not be conducted through the common battery leads to the other equipment on the aircraft.

This particular vibrator power pack is designed to operate from a 12-volt direct current source. This is available from an external battery cart that is used as a power supply for the plane during the ground check.

Mechanical Details

Normal use requires a unit that will withstand all types of weather, encountered on the airport. In addition, the unit must be readily accessible for periodic inspection. To meet these conditions certain precautions are necessary. The unit, therefore, is housed in a case of light gauge steel construction. The cover is seated in a seal on the edge of the case and secured in place by use of two wing-nuts. For purposes of accessibility, the chassis with all parts are attached to the panel. Removal of the panel is accomplished by drawing two

[1]Morgan's "Aircraft Radio and Electrical Equipment," page 264 (Pittmann), and Henney's "Radio Engineering Handbook," page 601 (McGraw-Hill).

screws. All parts are available for inspection. In remote cases where greater accessibility is needed, it is only necessary to draw four screws of the "stand-off" on the back of the chassis. Special cabling of the two section chassis permits the rear chassis to be folded back.

All controls for normal operation are located on the face of the panel. These controls can be set up in the shop and the cover put in place in order to protect it from the weather. The unit where the controls are properly set up will be in operating condition when the battery cable is connected to the battery.

Control Panel

On the test unit panel in addition to the "on-off" power switch and the "power output" control is a "metering switch." The purpose of this switch is to permit use of a single meter that is connected in the vital circuits at will, to determine whether the circuits are operating within normal limits and to serve as an indicator for alignment. Two separate switches labeled "automatic-manual" and "modulation" are provided. This permits selection of a continuous modulated signal so that any one of the three a-f is available, or with the use of the automatic feature the three audio frequencies that are delivered at periodic intervals. These two switches are electrically interlocked so that with the selection of the automatic condition, the three position frequency-selector switch action is voided and is active only when the function switch is in the "manual" position.

Response Characteristics

The crystal-controlled 75 mc carrier tolerance is held within the limits of plus or minus 0.03% and the maximum output is not less than three-quarter watts. The output is variable from a minimum of 0.05 watts to maximum. The modulation audio frequencies must be free of harmonics to a degree that does not affect normal functioning of the receiver filters. In this instance, 80% modulation is used. Tolerances of the audio frequencies are plus-minus 2% for 3000 cps, 3% for 1300 cps and 5% for 400 cps.

The unit is a portable, single unit style of convenient size and light weight. A battery cable with suitable connectors is an integral part of the unit. A polarized connector is used to prevent incorrect connection to the battery. The antenna is of the telescoping type, which when extended equals a one-quarter wave. By use of a spring contact, the antenna is connected to the r-f output circuit when the panel is installed in the case. All parts that are apt to be affected by moisture are wax impregnated to avoid variations in operational characteristics and to avoid premature failure.

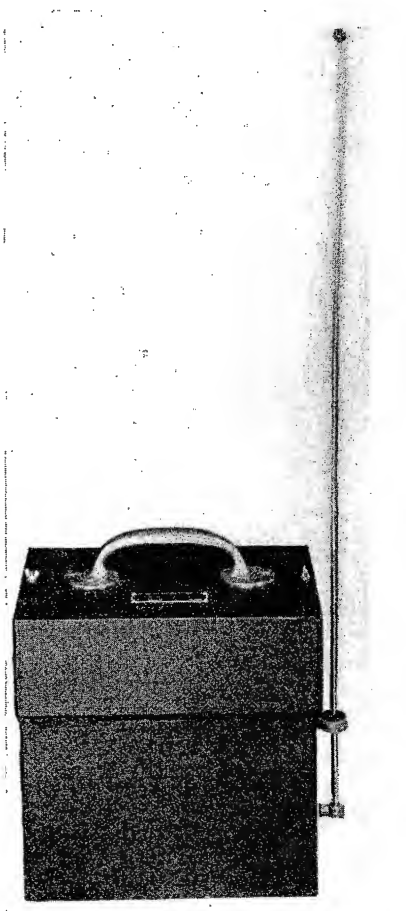
Additional Circuit Notes

The oscillator 6N7 tube section is designated 1a. An "A-T" cut crystal is used in the grid circuit designated XTAL, which also includes the grid leak resistor, R2. The oscillator plate circuit contains L1-C2 tuned to resonate to the crystal frequency, C1 is the oscillator plate by-pass condenser.

Harmonic Amplifier

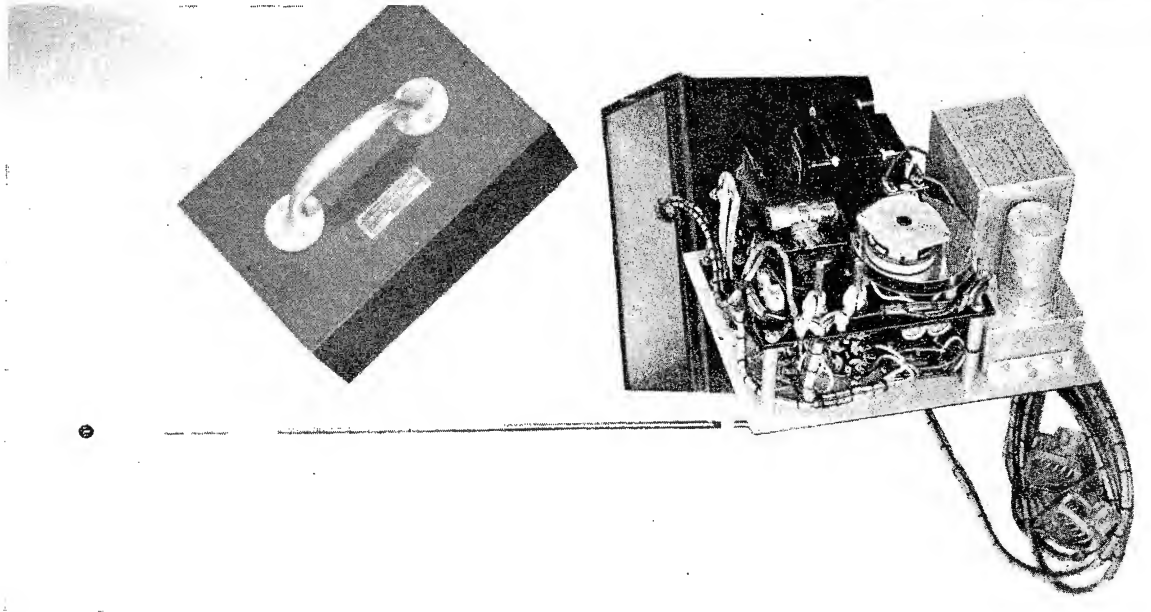
The 1b section of the 6N7 tube is a part of the harmonic amplifier. C5 and R3 provides coupling of the oscillator to the grid of the amplifier. The reso-

(*Continued on page* 45)



At right appears the compact unit with its handled cover, providing portability. In the interior view shown below, we see the vibrator pack, and the simple motor which derives its power from this pack and operates the rotatable switch for a-f control.

Courtesy Communications Co.



A Report on the

ROCHESTER FALL MEETING

by LEWIS WINNER
Editor

POST-WAR planning, standardization, alternate materials and Government procurement problems were among the featured topics of discussion at the first wartime Rochester Fall meeting held at the Saginaw Hotel on November 9th.

Dr. Baker's Message

In his annual address, Dr. W. R. G. Baker, director of the RMA engineering department and vice-president of General Electric, pointed out that standardization is an essential. It is particularly vital, he explained, since engineers can improve on many methods when developing the necessary standards. Thus, standardization becomes a very effective accessory to development work. This is particularly important, Dr. Baker explained, not only in our present efforts, but in our post-war planning program. And post-war planning today is indeed a very essential factor, said Dr. Baker.

Committees like the NTSC will play an important role in establishing standards that will be useful today and in our post-war efforts, according to Dr. Baker. In television, incidentally, lies a basis of development that will assume vast post-war proportions. Thus, explained Dr. Baker, it will be necessary to determine not only what should be done about television, but to the greatly expanded frequency channels promoted by television interest.

In establishing standards, manufacturprocesses have been propelled to new highs. Manufacturers have been able to streamline their production facilities and unravel development problems heretofore impossible, explained Dr. Baker.

Dr. W. R. G. Baker (left), director of the RMA engineering department and vice-president of General Electric, congratulating James Lawrence Fly, chairman of the FCC and the BWC, on his dynamic talk on post-war planning, which was presented at the annual banquet. For the highlights of Mr. Fly's talk see pages 39 and 40 of this issue.

Lt. Com. Chamberlain's Report

The problems of manufacturing for the Navy were discussed by Lieutenant Commander A. B. Chamberlain of the Radio Branch, Bureau of Ships. It is inconceivable for anyone to realize the ruggedness that must prevail in instruments made for the Navy. For instance, said Commander Chamberlain, one must be able to take a receiver and literally be able to bounce it around without in any way damaging the operating efficiency. That type of service is but a trifling instance of what is met during warfare on the seas. When the huge guns fire and the vessels go into battle, the punishment that radio equipment must take is beyond description. Yet, said Commander Chamberlain, there is no time for apologies or excuses; the equipment just must work.

Although the specifications sent down to manufacturers are involved and often frightening in their scope, explained Commander Chamberlain, this thoroughness is essential in view of the uses for which the equipment is intended. It must be remembered, too, that there are many branches of the Navy which require radio equipment. Each of these branches, explained Commander Chamberlain, has its own particular program of operation. The equipment must be put through paces that are variable and unusual.

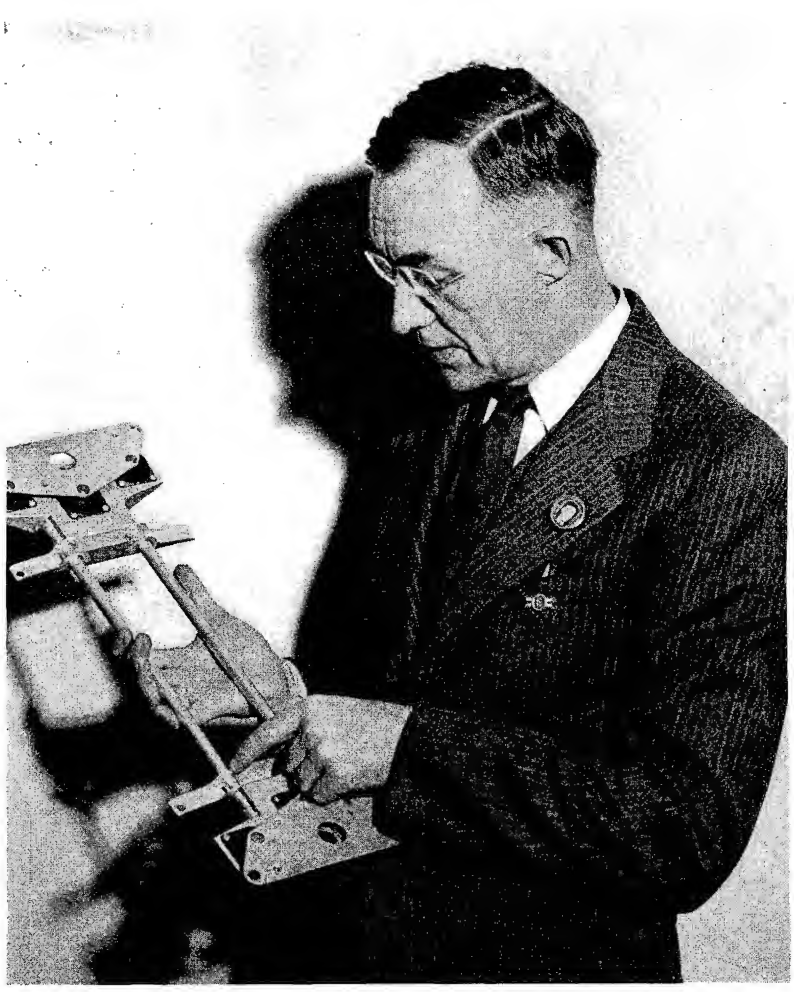
Capt. MacArthur's Expediting Talk

The Army-Navy communications production expediting agency was represented by Captain Billings MacArthur, who told of the various steps that are involved in selecting plants and materials required for the manufacture of communications equipment. He explained how plants other than those identified with radio manufacture could be prepared to aid the program. This point has been well portrayed recently by the appointment of manufacturers,

who only made toys and other small items of constructional nature, to manufacture assorted radio components. Not only is complete knowledge of the productive facilities of every plant available, but of their development and research facilities, too, he explained. An inventory of those plants that may have only made one or two pieces of a certain object in preparation for greater production is also available. Thus, it is possible, he explained, to obtain a complete map of anticipated procedure in the planning of production today. This procedure does not only involve prime contractors, but sub and sub-sub-contractors as well. In other words, those plants that may play but an apparently small role in completing the manufacture of an item are still as important as the prime contractor, for the link of manufacture must be a strong one from end to end.

It must be remembered, explained both Captain MacArthur and Commander Chamberlain, that we never know where the equipment will be used. It may go to the Arctic wastes or the heated tropics. And thus it must be made to perform equally well anywhere. While this is a point that has been repeated and explained before, these gentlemen said, it cannot be stressed too highly. We are fighting a global war and our equipment must be made for that global effort.

Captain MacArthur pointed out an excellent example of the utilization of facilities other than those identified with radio, who are now making radio apparatus. The particular manufacturer he referred to, formerly made electric lights for Christmas trees. Today they are making capacitors for dynamotors.



J. J. Farrell, designing engineer for General Electric, displaying one of the skeleton steel chasses that were designed to economize on aluminum, the material formerly used. The use of such alternate methods of manufacture in a variety of components effected a saving of over two million pounds of aluminum, Mr. Farrell explained during his paper.

German Aircraft Radio

Before a spell-bound audience, Dr. F. S. Barton, of the British Air Commission, spoke on German aircraft radio equipment. Illustrating his talk with slides, he explained the types of equipment used in bombers, reconnaissance planes, fighter planes, interceptors and dinghys. Outstanding among the features of these units were their compactness and ruggedness. Their electrical design was conventional and did not show any ingenuity. The circuits were those used in the days of 1935-1936. There was no denying, however, that they were exceptionally well built. This was particularly evident upon an inspection of the equipment itself which was placed on exhibit during the meeting. Some of the constructional features included a magnesium alloyed frame, milled variable condenser plates, a variety of gears and associated tuning assembles, etc.

An interesting aircraft device that Dr. Barton described was one used on emergency floats. The equipment has its own power supply (generated by a hand-operated unit) and antenna reel. It was capable of transmitting over several miles on water and about a mile and a half on land. Unfortunately, Dr. Barton was unable to present illustrations of this equipment, but it is believed that they will be released soon.

The Material Problem Today

The material problem was shown to be most important in a paper presented by J. J. Farrell, designing engineer for G. E. There are many factors such as man power, standardization and simplification that ordinarily are classified as the vital factors. Although man power is an important factor and a cause for concern, it is not of first importance, said Mr. Farrell. Explaining this, he pointed out that a military transmitter or receiver may be considered as a structure rather than as a machine. In general, he said, there is no relative motion between the component members other than that due to the elasticity of the materials of construction. While each structure may contain such units as relays and meters, a major share of the structure can be fabricated by the semi-skilled, explained Mr. Farrell. Therefore, if a basic force of skilled workers can be retained to provide the tools and fixtures for the unskilled, he said, and make a few precision parts which may be beyond the ability of the less experienced, it shouldn't be too difficult to take care of the rest of the project even if it requires that the work be done by women entirely.

Continuing his analysis, Mr. Farrell said that there is no doubt that standardization is important and that any improvement is desirable. But, he said, we know that there is more than one radio set which is used by the Army and Navy and there are others used in airplanes, tanks, etc. And everyone knows, he said, that the Government has set standards on various components for years. Therefore, he pointed out, we have standardization. It is not perhaps enough, but even if we could improve it over night, it is doubtful if the increased output of the industry would be too noticeable.

Simplification was the next topic of discussion by Mr. Farrell. In his explanation on this subject, he showed that neither the Government, laboratories or private industry have ever been lax in this respect. For where they found they could use one tube in place of two, such was usually the procedure. And with war-time maintenance and service in mind, certainly the Govern-

(*Continued on page* 34)

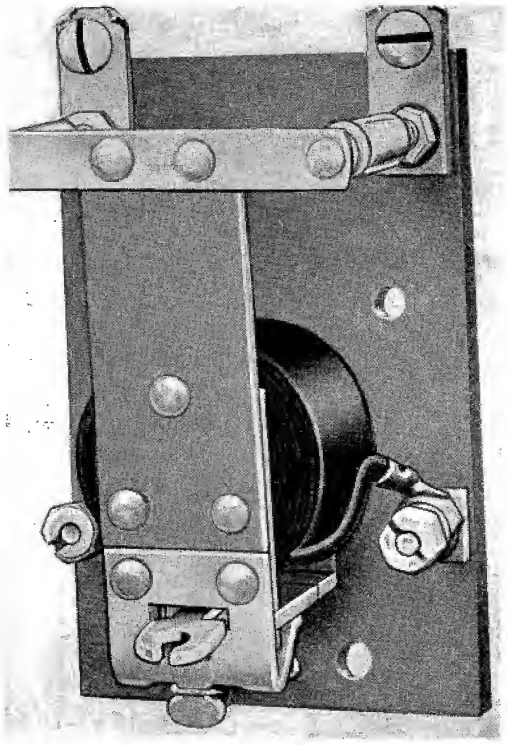


Figure 1
A Ward Leonard band switching relay.

THE RELAY IN

A topical review of the many types of relays that are serving so effectively today

by RALPH G. PETERS

ALTHOUGH relays have always occupied an important position in communications development and design, they have during the past months, become an exceedingly vital component. Their applications have multiplied for an unprecedented variety of positions, essential to equipment of both military and vital civilian uses.

Among the popular types that have risen to new heights of acceptance are, for instance, band switching relays. These provide automatic frequency changes by remote control, using in most instances a two-wire system. Thus the necessity of long radio frequency leads is eliminated.

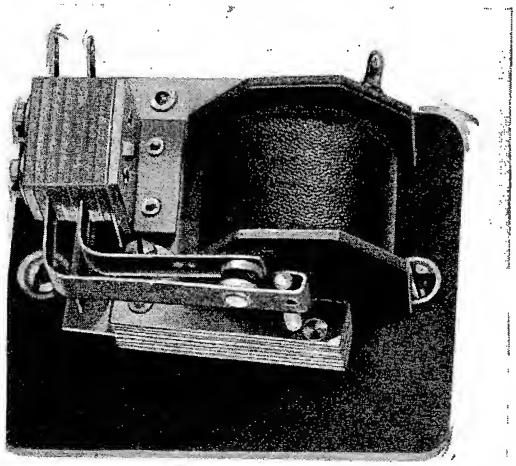
Low-loss Insulation a Factor

Special low-loss insulation, an important factor in many types of relays, is particularly essential in the design of this type of relay, since it is necessary to avoid leakage and creepage of both high frequencies and high voltage. Accordingly it has become necessary to use such materials as micalex. In addition, generous spacings of contacts and terminals are also essential to avoid leakage. An effective example of this design is shown in Figure 1.

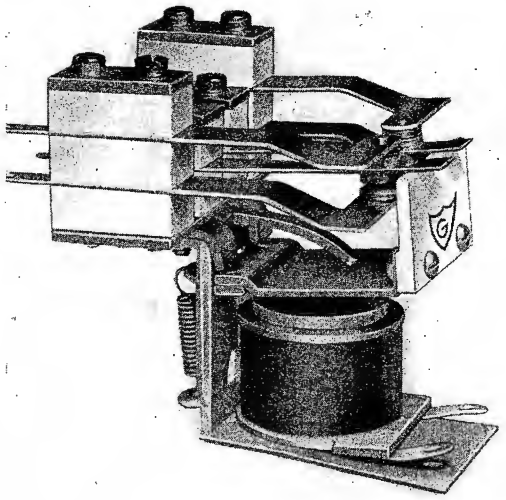
Keying Relays

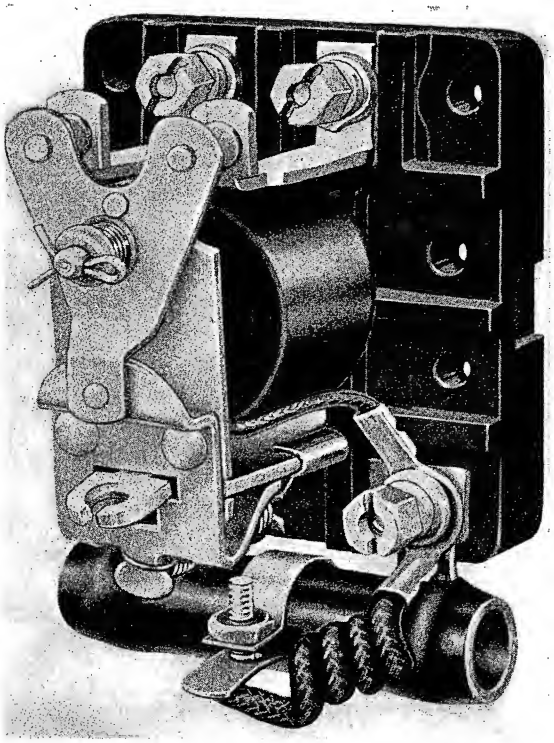
Keying relays are also among the important items of the day. These are usually low voltage units, controlling high voltage transmission. There are those that are used for center tap or grid bias keying, and others that can be used with grid controlled high voltage rectifier tubes. The grid bias keying units are usually made for both operation off either a 6 volt a-c or 6 volt d-c circuit. They can sometimes be used with dry cells too.

In the control of battery receivers

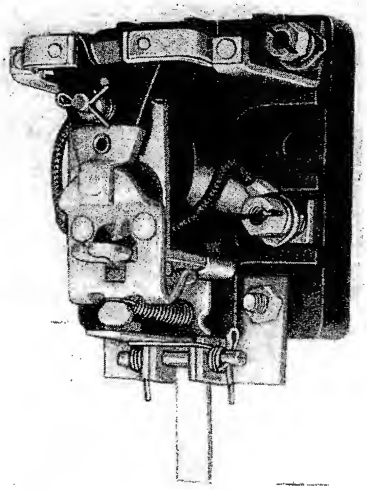


Figures 2 (top) and 3 (bottom)
At top we have a Guardian Electric keying relay; below an antenna relay.





Figs. 4 (left); 5 (below)
At left, we have Ward-Leonard underload relay, while below appears an overload relay.



these relays are also effective. A relay that can be used for this purpose is shown in Figure 2. This particular model can be used for transmitters using filament center tap keying of any stage up to 2,000 volts on the plate. They may be used also as the primary keying of control of power supplies up to and including 500 watts as well as for grid controlled rectifier keying of 3,000 volt power supplies.

The antenna relay, another popular item, affords many important services. For instance, it can be used for single wire-fed installations, or where two are used in an open line system, possible mismatch caused by distorting the feed system to provide for relay installation, can be avoided. They are also useful in break-in circuits, heavy duty keying in the primary with contacts in parallel, grid controlled rectifier keying, in remote motor control, etc. A typical antenna relay is shown in Figure 3. This unit uses the low loss Alsimag 196 for insulation. Its control capacity is up to one kilowatt, on either audio or radio frequency circuits, up to and including 28 megacycles.

Probably two of the most famous members of the relay family that are seeing service in countless applications today are the overload and underload relays, particularly those of the midget type. The overload relays provide protection against tube overloads which may occur if excitation is lost when the resistance bias is used on the power amplifier. Overload may also occur while tuning the transmitter. The underload relays provide protection to class B modulator tubes and possible breakdown of the class B modulator transformer secondary, should the class C tubes fail to hold the load due to loss of excitation. In this latter instance, if the circuit drops the load, the relay coil is de-energized and the contacts open, thus preventing possible damage to the class B transformers or to the tubes. These relays usually are adjustable to carry any flow of current from 150 to 600 milliamperes. Typical examples of these relays are illustrated in Figures 4 and 5 on the opposite page.

Some underload and overload types available have the re-set button feature included in the form of a panel control.

Rectifier circuits require control relays in effective quantities today, particularly the trip-free types. They are essential since rectifiers should always

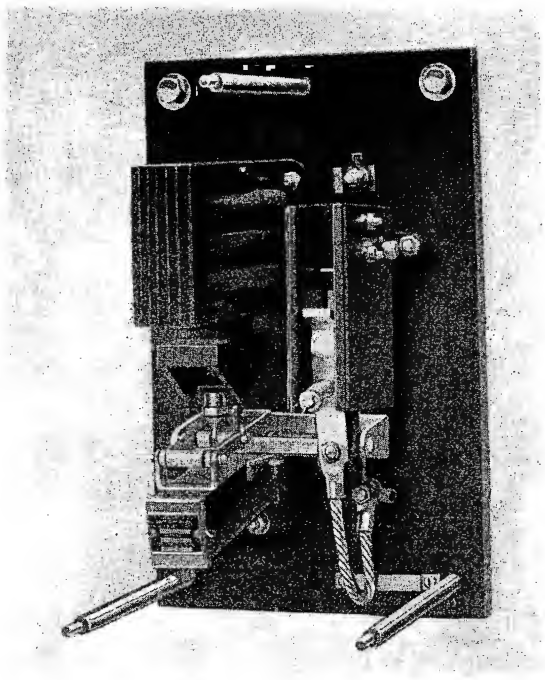
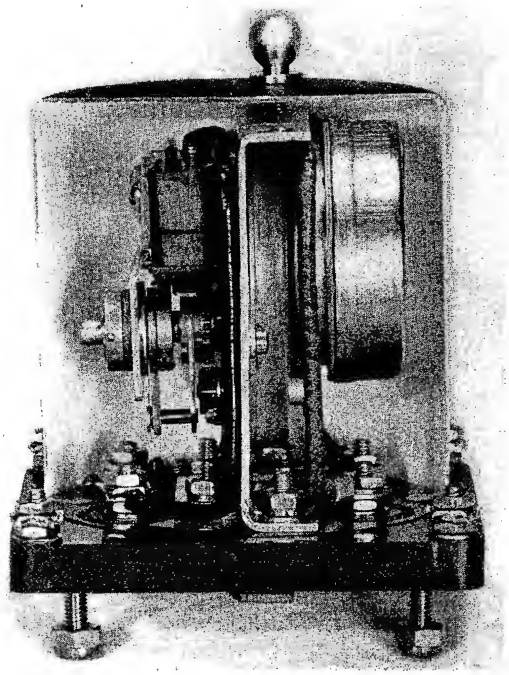
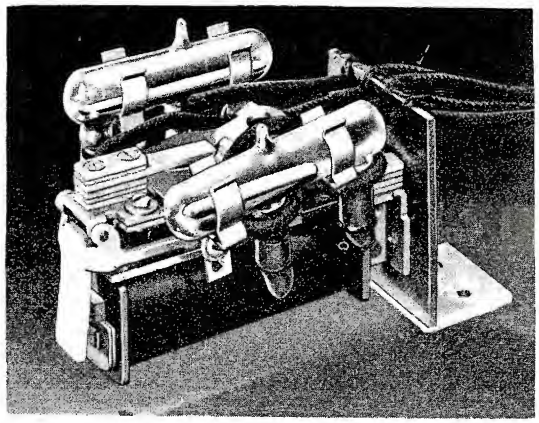


Figure 6
A Roller-Smith trip-free control relay.

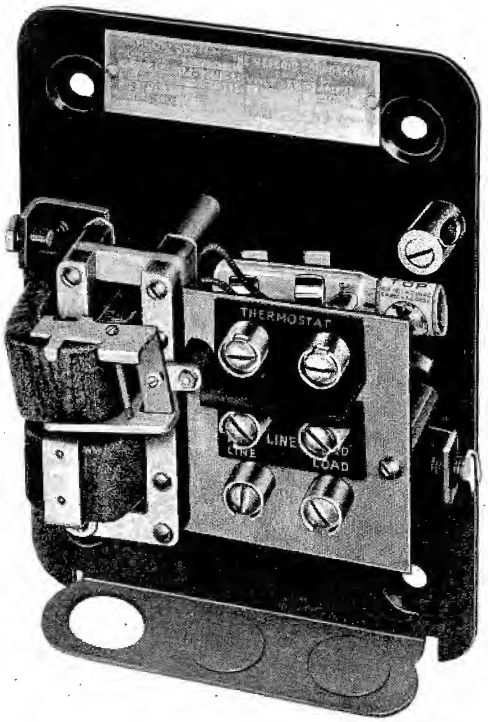


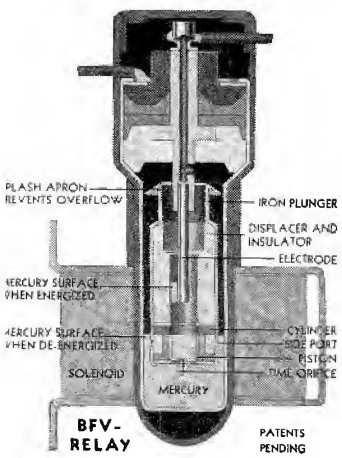
Figs. 7 (top); 8 (below)
Top, R. W. Cramer time delay relay.
Below, Automatic Electric mercury relay.

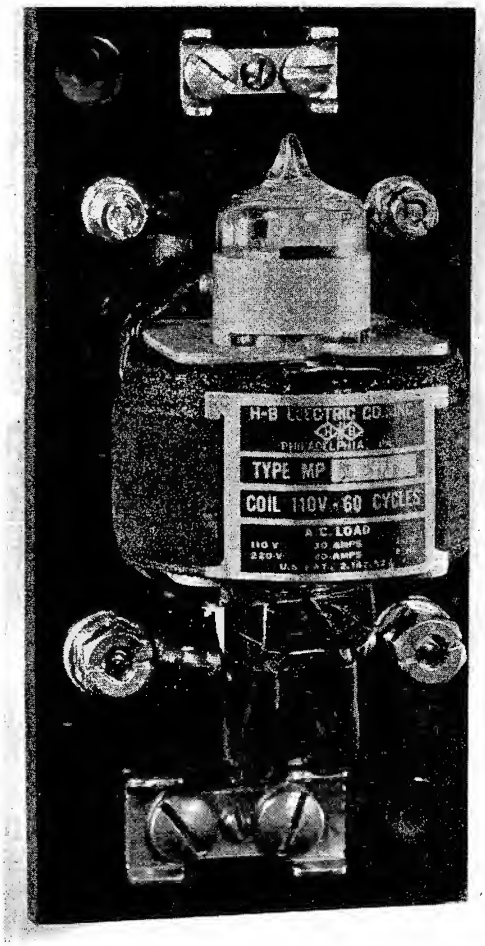


Figs. 9 (right): 10 (below)

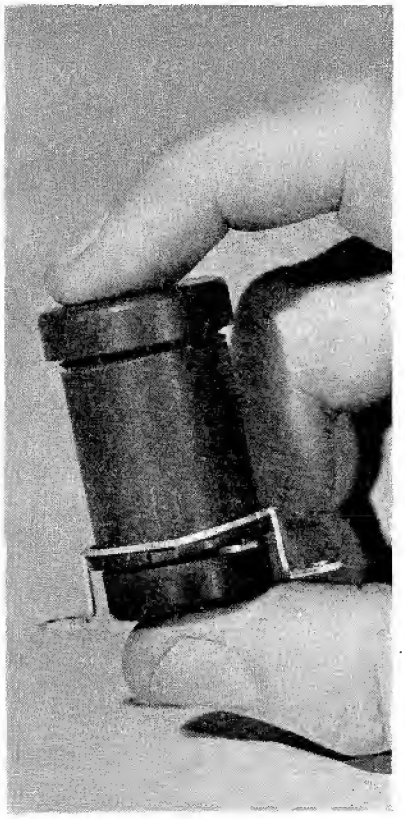
At right appears a Mercoid transformer type mercury relay. Below is a Durakool mercury time delay relay.







Figs. 11 (top), 12 (below)
Top, H-B Electric plunger type relay with one movable part. Below, a G.E. dust-tight aircraft type relay.



have some means of limiting the short time period that the rectifiers are in use, since the rectifiers carry during the short interval of time, current considerably in excess of the continuous current carrying capacity. A typical relay having these characteristics is illustrated in Figure 6. These units may be had with coil assemblies for a-c or d-c operation. The coils for operation on d-c are made for intermittent service. If a direct current coil is to be subjected to continuous service, it must be connected in series with a resistor to limit the relay coil current shortly after the relay armature moves to the closed position. An auxiliary switch or second pole is usually provided for this service. For a-c, the coils are built for continuous operation.

Time Delay Relays

To delay the closing of plate circuits in transmitters or rectifiers, or control sequence of operations, we have the time delay relays which are in use in so many installations today. In Figure 7 appears such a relay which operates on a-c and supplies an adjustable or a fixed time delay between the closing of one circuit and the subsequent closing or opening of a second circuit. It has an automatic reset. Thus the time will automatically reset to the starting position after each operation or upon the opening or interruption of the power supply to the control circuit. A motor starts and stays in synchronism on plus or minus ten percent of the rated voltage. Where it is necessary to use the device as a time limit relay and lock-out of the control circuit if the operation exceeds a preset time interval, a manual reset feature can be included.

The switch unit in this particular device is a totally enclosed, light acting, quick-make, quick-break type with silver contacts rated to carry a 1/3 horsepower load, 250 watt incandescent lamp load, 1,200 watt heater load or solenoids in which the inrush current does not exceed 15 amperes at 110 volts. The synchronous motor operates at 450 rpm, and is of the self-starting type with an enclosed gear train, and built-in magnetically operated gear clutch, all operating in oil. Models are available for flush or surface mounting.

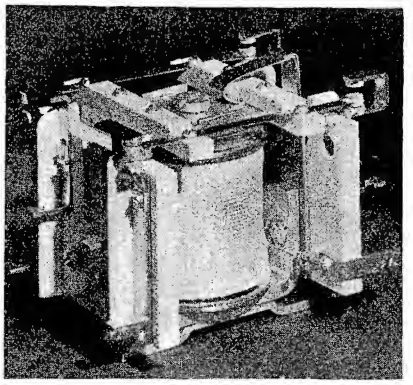


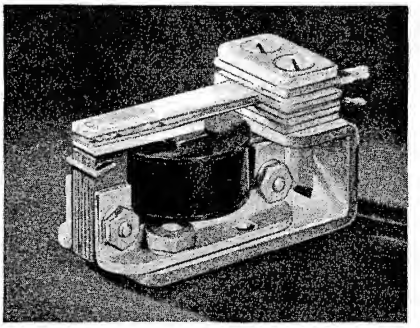
Figure 13
A G.E. aircraft type relay with double break contacts that will handle up to 1,000 volts d-c.

Mercury Contact Relays

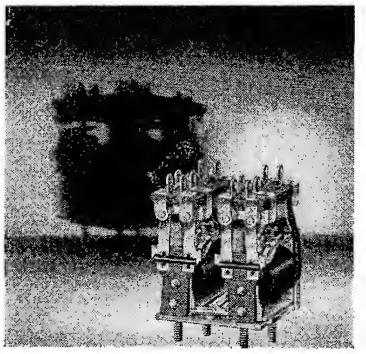
Seeing a great deal of service today are the quick-acting mercury contact relays. There are many types in this classification. In Figure 8 appears a type that is particularly adaptable for hazardous atmospheres. In this unit the mercury contact elements are hermetically sealed. It has its natural limitations in that it cannot be used in locations subject to vibration, tilting or other movement. And in addition, it must be in a horizontal position as illustrated.

In Figure 9 appears another type of mercury type relay, this one of the transformer type, with a fixed primary coil and a movable secondary coil. The transformer is self-contained in the relay, as the primary coil induces 24 volts in the secondary coil by transformer action. When the low voltage circuit is closed, magnetic repulsion moves the secondary coil upward and closes the switch circuit. In this way, the possibility of humming or chattering metal-

(*Continued on page* 37)



Figs. 14 (top), 15 (bottom)
Top, an Automatic Electric 400 cycle, 26 volt aircraft relay. Below, an Allied Control Co. aircraft relay for latching service.



The Steady State

RESPONSE OF CIRCUITS

*(PART TWO OF A TWO-PART PAPER)**

Examples of solutions presented in lucid form in this appendix

by D. L. WAIDELICH

Ass't Professor of Electrical Engineering, University of Missouri

When a sinusoidal voltage

$e(t) = E_m \sin(\omega t+\theta) = E_m/2j\left[\epsilon^{j(\omega t+\theta)} - \epsilon^{-j(\omega t+\theta)}\right]$

is applied to a circuit with an operational impedance $Z(p)$, the steady state current is

$$i_s(t) = \frac{E_m}{Z}\sin(\omega t+\theta-\varphi)$$

$$= \frac{E_m}{2j}\left[\frac{\epsilon^{j(\omega t+\theta)}}{Z(j\omega)} - \frac{\epsilon^{-j(\omega t+\theta)}}{Z(-j\omega)}\right]$$

where Z is the magnitude and φ is the angle of $Z(j\omega)$. Now if

$$\frac{1}{Z(p)} = p\int_0^\infty \epsilon^{-p\tau} A(\tau)\,d\tau$$

$$\text{then: } \frac{1}{Z(p)} - A(0) = \int_0^\infty \epsilon^{-p\tau} A'(\tau)\,d\tau \qquad (9)$$

where the real part p is finite and greater than zero.

For dissipative networks the terms of $A'(\tau)$ are all of the form $(\tau^s\epsilon^{a\tau})$ where S is a finite integer or zero and a has a negative real part. Equation (9) will be true in this case even though the real part of p is zero.

$$\text{Hence: } \frac{1}{Z(j\omega)} = A(0) + \int_0^\infty \epsilon^{-j\omega\tau} A'(\tau)\,d\tau$$

$$\text{and: } \frac{1}{Z(-j\omega)} = A(0) + \int_0^\infty \epsilon^{j\omega\tau} A'(\tau)\,d\tau$$

$$\text{Then: } i_s(t) = A(0)\,E_m\left[\frac{\epsilon^{j(\omega t+\theta)} - \epsilon^{-j(\omega t+\theta)}}{2j}\right]$$

$$+\int_0^\infty (E_m/2j)\left\{\epsilon^{j[\omega(t-\tau)+\theta]} - \epsilon^{-j[\omega(t-\tau)+\theta]}\right\}A'(\tau)\,d\tau$$

or (10)

$$i_s(t) = A(0)\,E_m\sin(\omega t+\theta) + \int_0^\infty E_m \sin[\omega(t-\tau)+\theta]\,A'(\tau)\,d\tau$$

An expression somewhat similar to this has been obtained by Carson[9]

If $e(t)$ is now a non-sinusoidal voltage of period $T = (2\pi/\omega) = (1/f)$ and is expressed as the Fourier series,

$$e(t) = E_{DC} + \sum_{n=1}^{\infty} E_{mn}\sin(n\omega t+\theta_n)$$

the steady state current flowing as a result of the periodic voltage will be composed of a d-c term $[E_{DC}\,A(\infty)]$ plus a term similar to equation (10) for each of the a-c harmonic voltages or

$$i_s(t) = \frac{E_{DC}}{R'} + \sum_{n=1}^{\infty}\frac{E_{mn}}{Z_n}\sin(n\omega t+\theta_n-\varphi_n)$$

$$= E_{DC}\,A(\infty) + A(0)\sum_{n=1}^{\infty} E_{mn}\sin(n\omega t+\theta_n)$$

$$+\sum_{n=1}^{\infty}\int_0^\infty E_{mn}\sin\left[n\omega(t-\tau)+\theta_n\right]A'(\tau)\,d\tau$$

If the infinite series of infinite integrals may be replaced by the infinite integral of an infinite series, the current is:

$$i_s(t) = E_{DC}\,A(\infty) + A(0)\left[e(t) - E_{DC}\right]$$

$$+\int_0^\infty\left\{\sum_{n=1}^{\infty} E_{mn}\sin\left[n\omega(t-\tau)+\theta_n\right]\right\}A'(\tau)\,d\tau$$

$$= E_{DC}\left[A(\infty) - A(0)\right] + A(0)\,e(t)$$

$$+\int_0^\infty\left[e(t-\tau) - E_{DC}\right]A'(\tau)\,d\tau$$

or finally: (11)

$$i_s(t) = A(0)\,e(t) + \int_0^\infty e(t-\tau)\,A'(\tau)\,d\tau$$

Equation (10) is immediately recognizable as a special case of (11).

(a) The first example has the circuit diagram and voltage wave shape of Fig. 2.

$$Z(j\omega) = R + \frac{1}{j\omega C} \quad \text{or} \quad Z(p) = R + \frac{1}{pC}$$

$$\frac{1}{Z(p)} = \frac{1}{R}\,\frac{p}{p+\frac{1}{RC}}$$

From reference 10, formula 3.

$$A(t) = (1/R)\,\epsilon^{-(t/RC)}$$

$$A'(t) = -(1/R^2C)\,\epsilon^{-(t/RC)} \text{ and } A(0) = (1/R)$$

$$f'(t) = -(1/R^2C)\,\epsilon^{-(t/RC)}\left[1+\epsilon^{-(T/RC)}+\epsilon^{-(2T/RC)}+\ldots\ldots\right]$$

$$= -\frac{1}{R^2C}\,\frac{\epsilon^{-(t/RC)}}{1-\epsilon^{-(T/RC)}}$$

When $-T < t < 0$, $e(t) = \dfrac{E_m(t+T)}{T}$

$0 < t < T$, $e(t) = \dfrac{E_m t}{T}$

$T < t < 2T$, $e(t) = \dfrac{E_m(t-T)}{T}$, etc.

From equation (5) and if $0 < t < T$:

$$i_s(t) = A(0)\,e(t) + \int_{t-T}^{t} e(\tau)\,f'(t-\tau)\,d\tau$$

$$= \frac{E_m t}{RT} + \int_{t-T}^{0}\frac{E_m(\tau+T)}{T}\left[-\frac{\epsilon^{-\frac{t-\tau}{RC}}}{R^2C\left(1-\epsilon^{-T/RC}\right)}\right]d\tau$$

$$+\int_0^t\left(\frac{E_m\tau}{T}\right)\left[-\frac{\epsilon^{-\frac{t-\tau}{RC}}}{R^2C\left(1-\epsilon^{-T/RC}\right)}\right]d\tau$$

or $\quad i_s(t) = \dfrac{CE_m}{T} - \dfrac{E_m}{R}\,\dfrac{\epsilon^{-(t/RC)}}{1-\epsilon^{-(T/RC)}}$

$$i_s(t) = \frac{E_m}{R}\left[\frac{y}{2\pi} - \frac{\epsilon^{-(\omega t/y)}}{1-\epsilon^{-(2\pi/y)}}\right]$$

where $\omega/2\pi = f = 1/T$, the fundamental frequency and $y = \omega CR$, the ratio of resistance to reactance at the fundamental frequency.

The voltage across the resistance R has the same shape as the current i_s of Fig. 2. The voltage e_c across the condenser C, on the other hand, is given by the following equation for $0 < t < T$

$$e_c = E_m\left[\frac{t}{T} - \frac{RC}{T} + \frac{\epsilon^{-t/RC}}{1-\epsilon^{-T/RC}}\right]$$

and is shown in Fig. 5.

(b) Fig. 3 illustrates the circuit diagram and voltage wave form of the second example.

$$Z(j\omega) = \frac{(1/j\omega C)(R+j\omega L)}{(1/j\omega C)+R+j\omega L)}$$

or

$$Z(p) = \frac{(1/pC)(R+pL)}{(1/pC)+R+pL}$$

$$\frac{1}{Z(p)} = \frac{LCp^2+CRp+1}{Lp+R} = Cp + \frac{1}{L\left[p+(R/L)\right]}$$

This circuit has a pure capacitance path through it, and thus equation (6) must be used. From reference 10, formula 2:

$$\bar{A}(t) = (1/R)\left[1-\epsilon^{-(R/L)t}\right]$$

$$\bar{A}'(t) = (1/L)\,\epsilon^{-(R/L)t} \quad \text{and} \quad \bar{A}(0) = 0$$

$$\bar{f}'(t) = \frac{1}{L}\,\frac{\epsilon^{-(R/L)t}}{1-\epsilon^{-(R/L)t}}$$

When $-T < t < 0$, $e(t) = -E_m \sin\omega t$

$0 < t < T$, $e(t) = E_m \sin\omega t$

$T < t < 2T$, $e(t) = -E_m \sin\omega t$, etc.

where $T = (\pi/\omega)$

When $0 < t < T$:

$$i_s(t) = \omega CE_m\cos\omega t$$

$$+\int_{t-T}^{0}(-E_m\sin\omega\tau)\,\frac{1}{L}\,\frac{\epsilon^{-(R/L)(t-\tau)}}{1-\epsilon^{-(R/L)T}}\,d\tau$$

$$+\int_0^t(E_m\sin\omega\tau)\,\frac{1}{L}\,\frac{\epsilon^{-(R/L)(t-\tau)}}{1-\epsilon^{-(R/L)T}}\,d\tau$$

or

$$i_s(t) = \frac{E_m}{Z}\left\{\frac{2\sin\varphi}{1-\epsilon^{-\pi\cot\varphi}}\,\epsilon^{-(\omega t)\cot\varphi} + \sin(\omega t-\varphi) + \omega CZ\cos\omega t\right\}$$

Where $Z = \sqrt{R^2+\omega^2L^2}$ and $\varphi = \tan^{-1}(\omega L/R)$

The voltage across the resistance R is given by the following equation for $0 < t < T$

$$e_R = E_m\cos\varphi\left[\frac{2\sin\varphi}{1-\epsilon^{-\pi\cot\varphi}}\,\epsilon^{-\omega t\cot\varphi} + \sin(\omega t-\varphi)\right]$$

and is shown in Fig. 6.

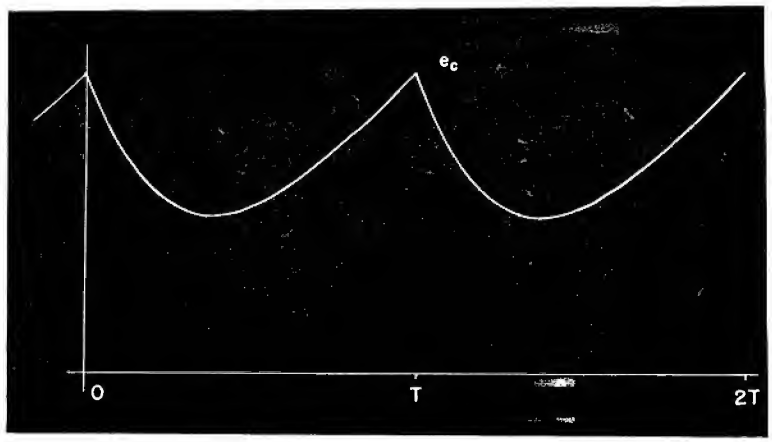


Figure 5

Although the voltage across the resistance R has the same shape as the current is in Figure 2 October COMMUNICATIONS, the voltage e_c across the condenser C, on the other hand takes the form as shown herewith, and explained by the equation on this page.

*Part 1 appeared in October, COMMUNICATIONS.

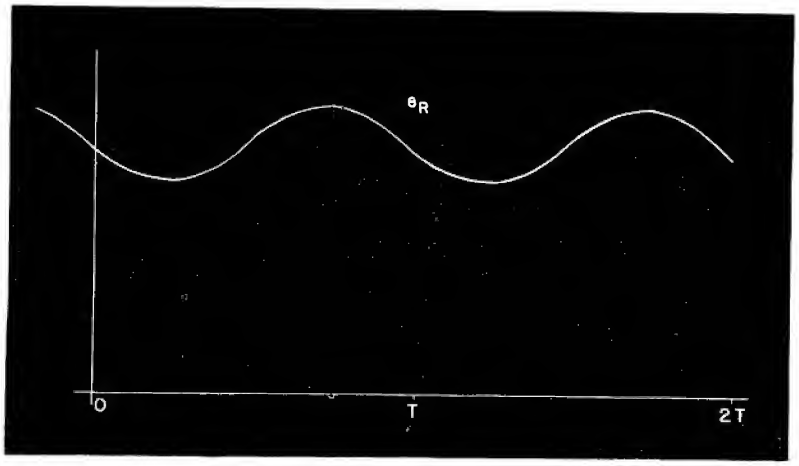


Figure 6

In Figure 3 (October COMMUNICATIONS), the circuit diagram and voltage wave form of the second example (b), is shown. In explaining this solution, an explanation of the voltage across the resistance R is given as shown here graphically.

(c) When a square wave of voltage is applied to a pure inductance, the resulting current is given in Fig.4 and may be calculated as follows:

$$Z(j\omega) = j\omega L \quad \text{or} \quad Z(p) = pL$$

$$\frac{1}{Z(p)} = \frac{1}{pL}$$

This circuit is a pure inductance, and hence equation (7) must be used.

When $-(T/2) < t < 0$, $e(t) = -E_m$
$0 < t < (T/2)$, $e(t) = E_m$
$(T/2) < t < T$, $e(t) = -E_m$
$T < t < (3T/2)$, $e(t) = E_m$, etc.

When $0 < t < (T/2)$

$$i_s(t) = \frac{1}{L}\int_0^t E_m\,dt - K = (E_m t/L) - K$$

and when $(T/2) < t < T$:

$$i_s(t) = (E_m T/2L) + (1/L)\int_{T/2}^{t}(-E_m)\,dt - K$$
$$= E_m T/L - (E_m t/L) - K$$

where

$$K = (1/T)\int_0^{T/2}(E_m t/L)\,dt + (1/T)\int_{T/2}^{T}[(E_m T/L) - (E_m t/L)]\,dt$$

or $K = (E_m T/4L) = (E_m \pi/2\omega L)$ if $T = (2\pi/\omega)$

Finally when: $0 < t < (T/2)$:

$$i_s(t) = \frac{E_m}{\omega L}\left(\omega t - \pi/2\right)$$

and when $(T/2) < t < T$:

$$i_s(t) = \frac{E_m}{\omega L}\left(\frac{3\pi}{2} - \omega t\right)$$

This steady current may also be calculated by assuming a resistance R in series with the inductance L, calculating the current by the use of equation (5), and then putting R equal to zero in this result. When $0 < t < (T/2)$ and R is not zero, the current is

$$i_s(t) = \frac{E_m}{R}\left[1 - 2\,\frac{\epsilon^{-(R/L)t}}{1 + \epsilon^{-(RT/2L)}}\right]$$

When R is put equal to zero:

$$i_s(t) = \frac{E_m}{\omega L}\left(\omega t - \frac{\pi}{2}\right)$$

Reference Data

The proof of the equation (3) presented in the first part of this paper has been outlined in the first section of this appendix, and the proof requires that the networks be dissipative in nature or in other words, that the roots of Z(p) all have a negative real part. This is true for all physically realizable networks, and for many problems it would be sufficient to stop here. Non-dissipative networks (roots of Z(p) have a zero real part) are used, however, as theoretical approximations to dissipative networks which have relatively small amounts of resistance, and hence non-dissipative networks should be discussed also. In the following if a network has a Z(p) with at least one root having a zero real part, it will be classed as a non-dissipative network.

In non-dissipative networks there are an infinite number of steady state responses because some or all of the transient terms (providing their coefficients are not zero) will never die out and for each different value given to the coefficients of these terms a new steady state response will result. One of these responses must be chosen, and the one chosen in most cases is that approached by allowing the network to be dissipative and to have resistance and then to make these resistances approach zero as a limit. This is equivalent to giving to the roots of Z(p) a negative real part, calculating the steady state response, and then taking the limit of the response as the real part of these roots approach zero. In addition this method is equivalent to putting the coefficients of the transient terms equal to zero and will produce the same result also as equation (2). To use equation (3) in calculating the steady state response of non-dissipative circuits there are then two methods available. The first consists in putting resistances in the circuit, calculating the response by the use of equation (3), and then allowing all of these resistances to approach zero as a limit to give the response of the non-dissipative circuit. The second method is a variant of the first and consists in using finite resistances in the circuit so small that they will not affect for all practical purposes the response of the circuit.

Conclusion Notes

To facilitate an analysis of this appendix, in which solutions to both dissipative and non-dissipative networks are supplied, conclusion data presented last month, is repeated herewith. The usefulness of this new method and its application are explained.

Linear Networks

1)—*The steady state may be specified exactly for linear networks, although for the non-dissipative linear networks one of the infinite number of possible steady states must be chosen and the one chosen in most cases is that approached by a dissipative network as all of its resistances approach zero. For a non-linear network it appears that a more general definition of the steady state is necessary.*

Fourier Series Expansion

2)—*The steady state response of a circuit may always be expressed in the form of the Fourier series expansion, but many may also be expressed as a sum function of the series. The Fourier series is useful in obtaining the amplitudes of the harmonic currents, but is almost useless in finding the waveform of the current, while the sum function enables the waveform to be calculated very readily and also makes clearer the effect of varying the circuit parameters.*

Sum Function

3)—*This sum function has been calculated heretofore by two general methods both of which become rather tedious in most cases. Another method of calculating the sum function is introduced in this paper and has the advantages of being less tedious and more straightforward. This last method will also give the Fourier series expansions if it is wanted, and may be extended in addition to problems other than circuit problems.*

Solutions

4)—*This new method is not directly applicable, however, to non-dissipative networks, but methods of solving these networks are given.*

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[11] See reference 10, pages 63-67.

A New

TUBE REBUILDING PROGRAM

by ELLIOTT MARSHALL

WITH the decrease in production of many tube types have come increased efforts to institute methods that will prolong tube life. Some of these efforts have encompassed reactivation, circuit changes, conservation methods, repairing and last, but not least, the actual rebuilding of the tube.

In tube rebuilding appears a program that is probably not only the most ambitious, but truly a complete solution to the problem, too. For, it is possible to take tubes, as large as 20 kw in size, take them apart, replace defective parts and revacuum them so that the tube becomes as effective a component as it was when originally purchased. In fact, in many instances, tests have shown that it is even better. This condition is predicated on the percentage of gas in the metal itself, which affects the characteristics of the tube.

The New Rebuilding Plan

While the rebuilding of tubes is not a recent development, the impetus given to it by the recent emergencies has prompted not only the expansion of many plants, but also the introduction of new departments such as at RCA in Camden. Under the direction of Harold C. Vance, former broadcast engineering sales executive for RCA, and more recently with the Government division of RCA, this new section has propelled a program that should be welcomed by many station operators.

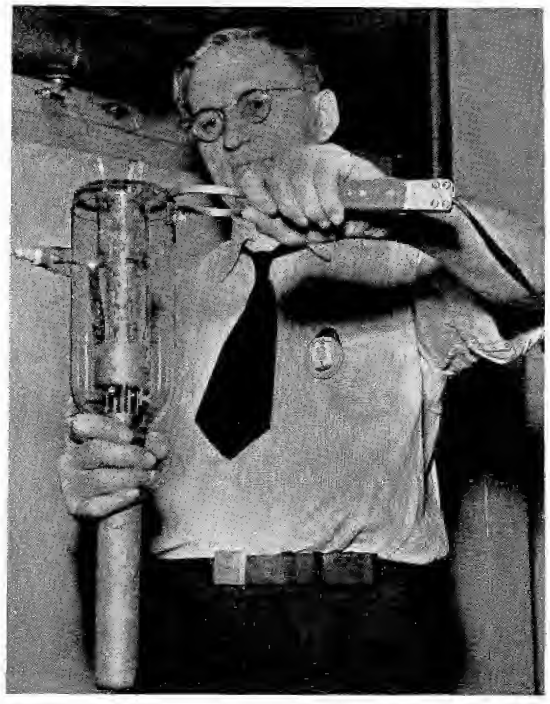
Triodes Being Rebuilt

At the present time three-electrode transmitting tubes of the water and forced air type, namely, the 891, 892, 207, 892-R and 891-R, are being rebuilt. These tubes are used in the output stages of 5 kw transmitters or as drivers for 50 kw transmitters. Although they are of the older type, records show that many are in use throughout the nation to date. In addition, these tubes contain a great deal of metal that would be difficult to obtain, were new tubes required.

The 891, 892 are r-f power amplifiers or modulators. Both are of the split filament type permitting operation from two-phase or single-phase alternating current as well as from direct current for all classes of service.

The 207, which is a very old friend of many, but still a very popular one, is used as either a r-f power amplifier, oscillator or class B modulator. It is a water-cooled unit and is capable of dissipating from 6.6 to 10 kw.

In the 892-R tube we have a very popular favorite, whose plate is capable of dissipating from two to five kilowatts. It is air-cooled and also contains a two-phase or single-phase alternating



The cutting of the glass envelope of a tube returned for rebuilding, as shown above, is a step involving an unusual degree of care. For not only is there the problem of releasing the glass in such form that will not injure the operator, but the problem of seeing that during this glass cutting, none of the elements are damaged. It is quite an art in which few are thoroughly versed. Although all tubes sent in for repair do not require the cuting off of the glass envelope, a more satisfactory analysis of the elements is possible, when the glass housing is out of the way. After the tube elements have been either repaired or replaced, a completely new glass envelope is supplied and put through the same revacuuming process employed for the production of new tubes.

At left, Harold C. Vance, in charge of the RCA rebuilding program, inspecting one of the rebuilt tubes, prior to shipment.

Assembling a new filament, and other internal parts as required, so that the tubes may meet standard requirements.

current filament that can be operated from direct current as well. The 891-R tube is similar to the 892-R in many respects. It differs in such characteristics as amplification factor, with the 891-R providing a factor of eight while the 892-R provides an amplification of fifty.

Reconstructing the Tube

In rebuilding these tubes it is necessary, of course, to reconstruct the tube which may in many instances require new material. However, before proceeding with such construction work, the complaint of the tube-sender is first analyzed and checked against the operation of the tube. If, of course, it appears as if a pitted anode has to be replaced only, such is the procedure. Incidentally, pitted anodes which are caused by a defective water system or flash-over between the anode and filament, have been frequent trouble causers.

The Tungsten Filaments

Practically in all cases the filaments, which are tungsten, have to be replaced. Although the grid structures, which are of tantalum in most instances, are generally found to be in good shape, there have been many cases where burnt sections have been found. This can be rectified by cleaning in some instances, thus ridding the surface of the gaseous condition caused by previous service.

The stems on most tubes are replaced since electrolysis which usually sets in, will certainly shorten the life of the rebuilt tube unless they are completely replaced.

Naturally, in replacing the elements just mentioned, it is necessary to replace the original glass with a new envelope. This new envelope receives the same revacuuming process as a new tube.

Radiators and Copper

The one tube section that is not completely replaced is the radiator. Fortunately, this can be used over and over again and requires only a refreshening process. This is very fortunate, indeed, because these radiators weigh quite a few pounds, and with the present copper situation as severe as it is, the replacement of these huge radiators would present quite a problem.

During the earlier portion of this discussion, mention was made that the tubes may last as long or longer in their rebuilt stage. Field tests thus far show very effective results. The results are really dependent upon the characteristics of the elements in the tubes themselves. If old elements are not contaminated, they should have less gas in the metal itself than new raw material and thus the efficiency may be better. It will be remembered that during normal operation the gases in the metal are brought to the surface so that they automatically perform a cleaning operation within itself.

Checking the Rebuilt Tube

Every effort is made to provide the rebuilt tube with new tube properties, that is, it proceeds through regular manufacturing tests, even as to the aging and testing procedures.

Development of Processes

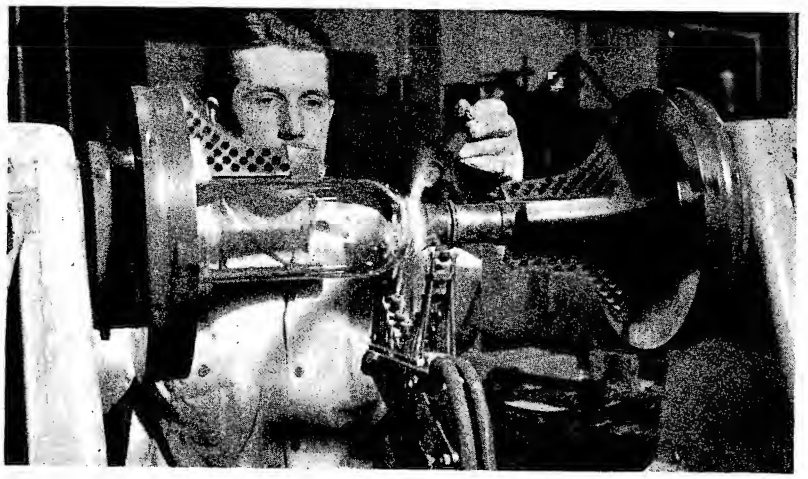
The repairing of tubes is not a simple project involving the replacement of one item for another. Process and manufacturing-procedure development is quite as complex as that involved in new tube practice. The present procedure involves many months of research, research that is also continuing not only to possibly improve the present methods, but to provide methods that may be used for rebuilding of other type tubes. Incidentally, the rebuilding of other type tubes will not only be predicated on future developments but also on available facilities.

Scheduling of Deliveries

Of course, at the present time any rebuilding of tubes can only be scheduled as facilities are available and not being used for new tube war production. There is hope that smaller types of tubes may be incorporated in a rebuilding program. It must be remembered, of course, that small type tube rebuilding presents an economic problem in that the elements involved are exceedingly small, in many instances involving hours of hand work. If, of course, this step becomes necessary, due to a scarcity of materials which will curtail production completely, such a program may have to be instituted, notwithstanding.

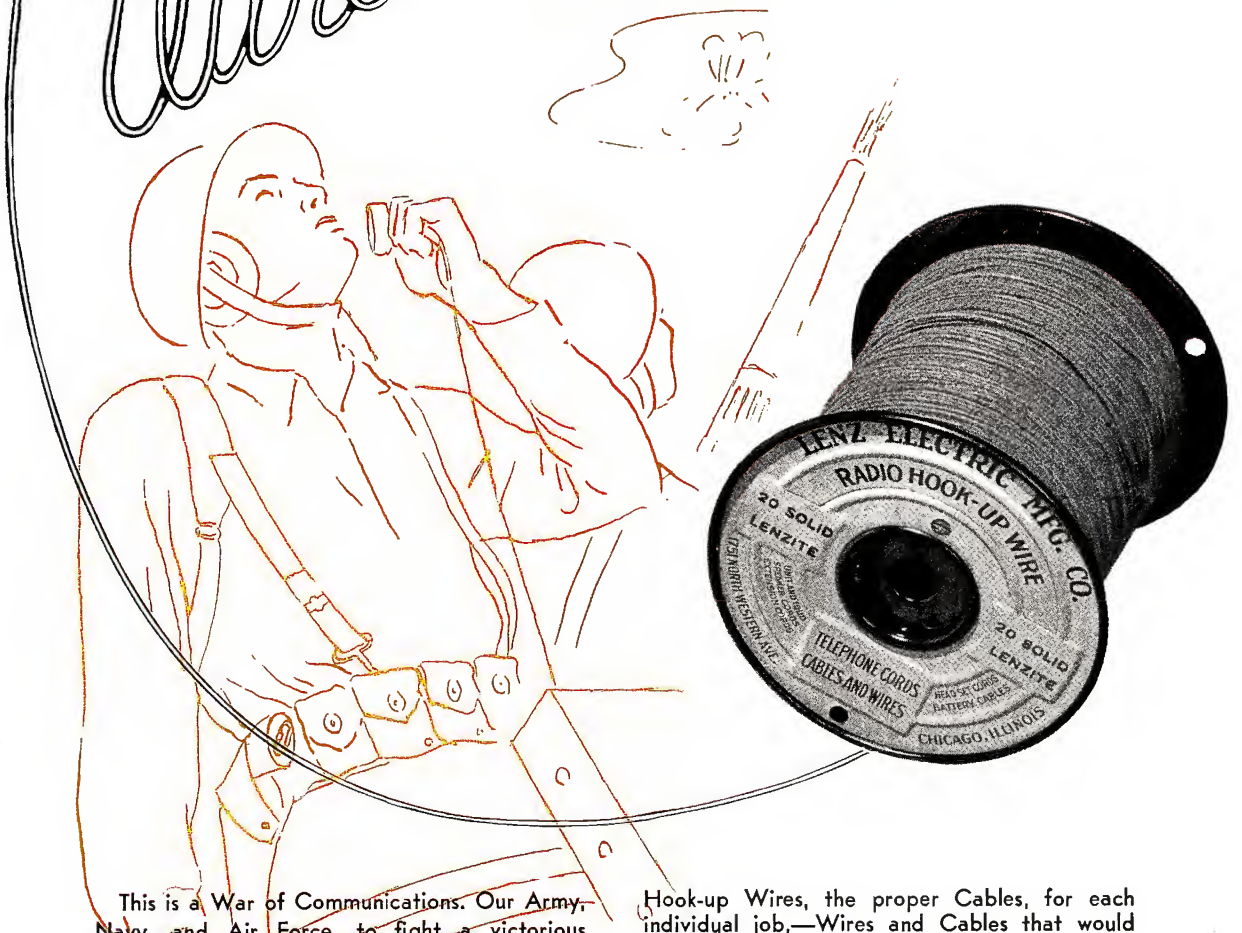
Although it appears as if the rebuilding of tubes involves quite an inventory of new materials; salvaging, refreshing, cleaning and other reactivating processes offset to a great extent this problem. In most instances, the elements with the greatest amount of metal can

(*Continued on page* 25)



Another delicate step involved in the rebuilding of tubes; sealing a new glass envelope to the copper anode on a lathe. Like the glass cutter, the glass sealer is a specialist who has had years of training in this unique art.

Wire FOR WAR!



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Manufacturers of Aircraft, Marine and Mobile Radio Communication Equipment

NEW YORK, N. Y. WASHINGTON, D. C.

Training Today With The

CATHODE RAY OSCILLOGRAPH

Visual methods facilitate instruction in theory and equipment maintenance.

by HARVEY POLLACK

Chairman, Technical Department, Melville Aeronautical Radio School

IN modern radio theory instruction today, the cathode ray oscillograph has become a vital accessory. No visual aid device posseses the versatility and thoroughness of this unit.

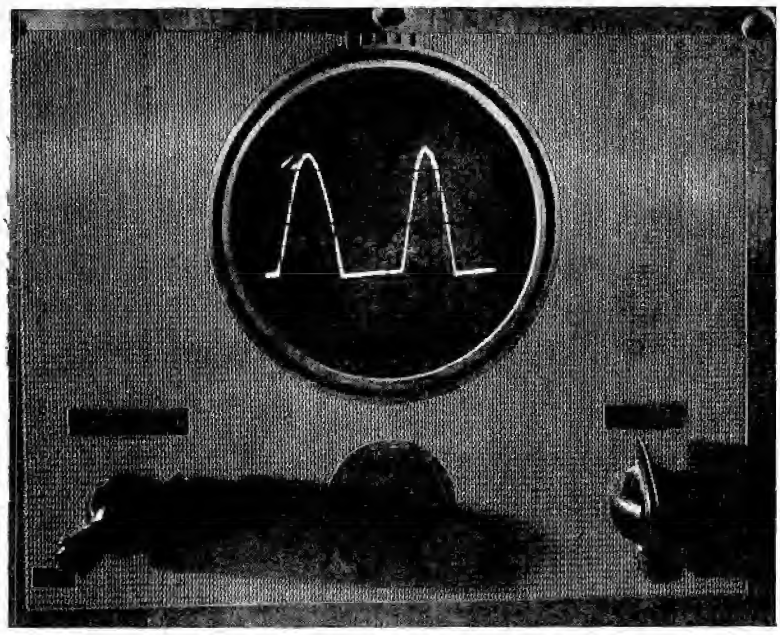
The oscillograph makes its first appearance in the theory classroom when the subject of alternating current is introduced. Students always find it difficult to picture mentally the generation of the sine curve form of alternating potential even though this is developed by means of rotating vectors on the blackboard. The oscillograph draws this diagram exactly as though it were produced by the rotating radius represented by the armature of the alternator. Measurements of frequency, wave length, amplitude, etc., may be easily taken right from the screen provided a stationary pattern can be obtained by synchronizing a linear sweep circuit with the input voltage to be examined. Most modern oscillographs have a sweep circuit with a linear time constant built in. This makes it possible to synchronize the sweep frequency with the incoming signal from 10 to 20,000 cycles per second by means of the control characteristic of a thyratron discharge tube. To obtain a trace of the 60-cycle power line voltage, the a-c leads are connected to the vertical deflecting posts, preferably through an isolating transformer, and the sweep frequency is adjusted to a low integral multiple of 60 cycles so that the number of complete cycles appearing on the screen is 2 or 3. After the wave has been examined, the sweep frequency may be changed so that more or fewer cycles appear.

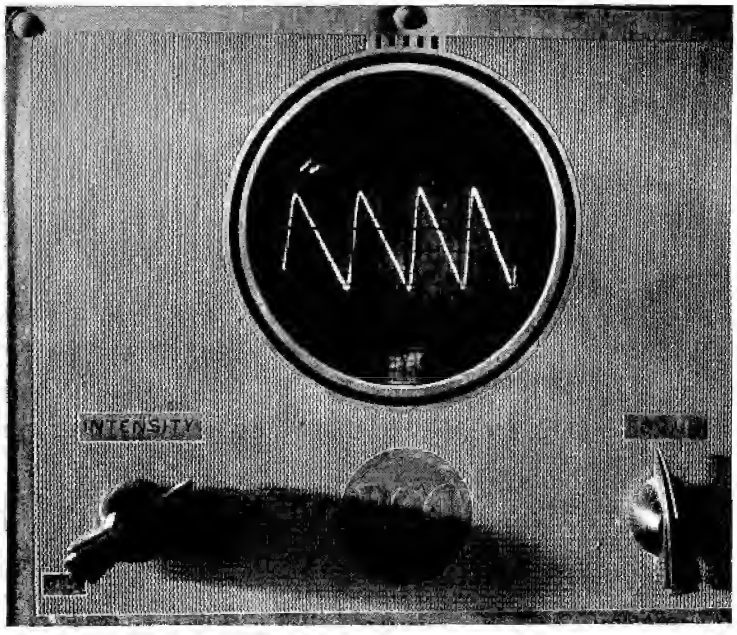
Studying Phase Shifts

When the subject of phase shift due to capacitance or inductance is approached, the oscillograph may be almost continuously employed to demonstrate the phase relationships between the emf and the current flowing in series circuits containing resistive elements in combination with reactive elements. If an electron switch is available, the voltage drop across a resistor may be applied to one set of input terminals and the equivalent drop across the condenser or inductance in series with the resistor may be applied to the second set of terminals. With the electron switch adjusted properly, it will now be possible to see two distinct wave forms which will be out of phase with each other by an angle depending upon the relative magnitude of the ohmic resistance of the coil or condenser. If the electron switch is not available, phase shift may be shown by applying the IR drop across the resistor to one set of deflecting plates and the condenser voltage across the other set of plates, both directly connected, so that the the amplifiers will be inoperative. An ellipsoidal pattern will be traced, its eccentricity depending upon the phase angle between E and I. If the angle is 90 degrees, the figure will be a perfect circle provided that the voltage

Figures 1 (left) and 2 (right)

At left, a wave form of the voltage at the output of a half-wave rectifier. At right, a sawtooth condenser discharge wave form. Both of these forms were obtained with the aid of the power supply unit, shown in Figure 3.





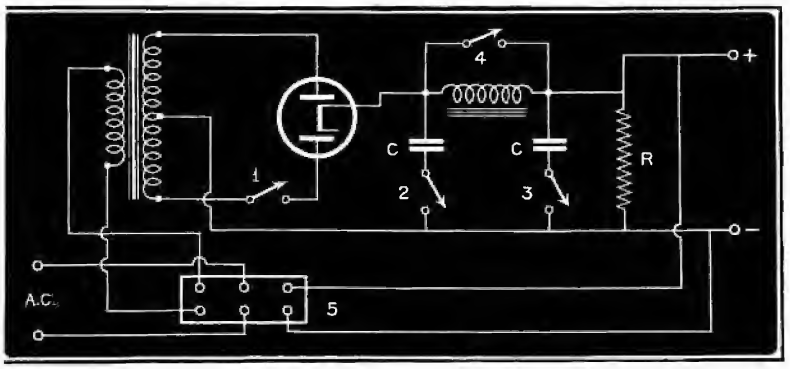


Figure 3

Circuit diagram of the versatile power supply that is linked to the cathode ray unit to illustrate characteristic properties of power components.

across the two components is identical. This may be ascertained by first adjusting the value of the resistance until the drop across it is the same as that across the particular condenser chosen for analysis.

Power Supply Demonstration Unit

Half-wave, full-wave, and filtered-rectified wave forms may be beautifully demonstrated by means of the oscillograph and a versatile breadboard power supply whose circuit diagram appears in Figure 3.

Power Supply Operation

The a-c wave is obtained on the screen first by throwing switch 5 to the right and the number of cycles in the stationary pattern counted. With all the other switches open, the half-wave pattern will appear when switch 5 is thrown to the left and its peaks may be counted to compare with the original full alternations. When switch 1 is closed, the rectifier delivers a full-wave pattern to the oscillograph for comparison. Manipulation of switches 2, 3 and 4 enables the operator to demonstrate the effect of the filter components on the wave form. The bleeder, R, is essential in this application to put a constant load on the filter condensers so that they can discharge with the periodicity necessary to produce the pattern desired.

Modulated R-F Wave Study

When the oscillograph is used to visually indicate the form of a modulated radio frequency wave, the instructor has in his possession an instrument which is unsurpassed for instructional purposes. The unmodulated carrier may be shown by connecting an aperiodic pickup coil to the vertical plates with the other end of the coil loosely coupled to the tank circuit; the vertical amplifier may not be used in this connection. The linear sweep is now adjusted so that a rectangle appears on the screen. When modulation takes place, usually by means of a low frequency oscillator or a tuning fork held in front of the microphone, the sine wave envelope immediately becomes apparent when the sweep frequency is adjusted to a low integral multiple of the fork or oscillator frequency. Percentage modulation is measured by increasing or decreasing the audio gain, or by varying the distance of the fork from the microphone. Trapezoidal modulation patterns are obtained by connecting the same pickup coil at the vertical posts, connecting, however, the audio output from the modulator to the horizontal posts, instead of using the internal sweep circuit. The theory of trapezoidal pattern is thus quite easy to explain. This method of modulation measurement is superior to the wave form method and is easier to use in most cases.

Audio Amplifier Distortion

Comparative audio amplifier distortion may be demonstrated in exactly the same way as was used for showing phase shift by means of the electron switch and the oscillograph. Here, the output of a 1,000-cycle hummer or audio oscillator is connected directly to the one set of electron switch input terminals, and the output of the amplifier which is being excited by the same hummer is connected to the other set of terminals. Two distinct wave forms, one representing the input signal and the other representing the output signal, are traced on the screen; their amplitudes may be equalized by internal electron switch gain controls and they may be compared by superimposing one upon the other by means of the balancing potentiometer. Phase shift and harmonic distortion are immediately apparent.

Maintenance Study with Oscillograph

The cathode ray oscillograph is also extremely useful as a medium of instruction in test and maintenance procedure.

Since the oscillograph is essentially a voltage measuring device, the first use which suggests itself is that of voltage measurement on circuit components which would easily be effected were a regular 1,000 ohm per volt multitest meter employed. The input impedance of the oscillograph is sufficiently high so that it will not materially load the circuit under measurement. For example, the amount of audio gain obtainable from a single tube voltage amplifier can be determined quite accurately by comparing the amplitude of the output voltage (a-c) with that of the input

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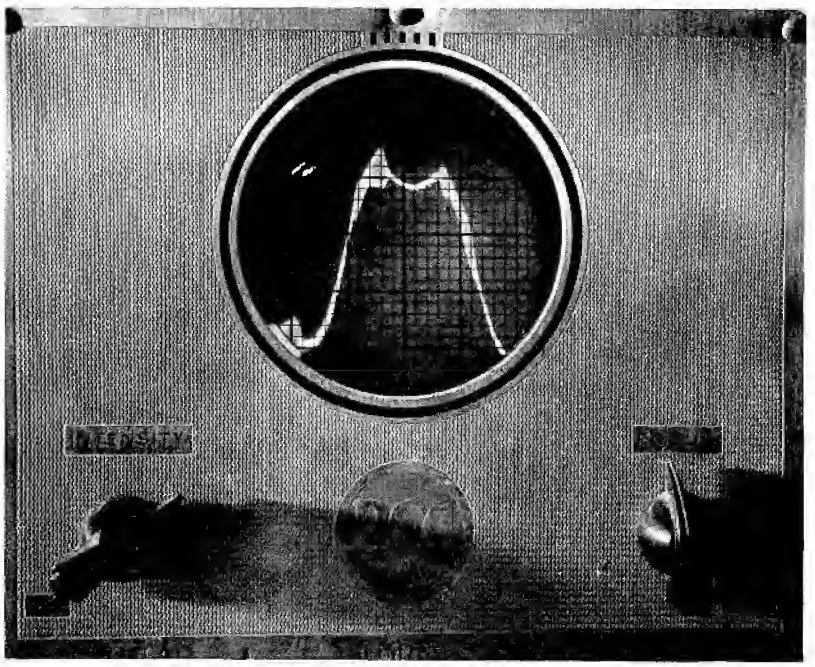
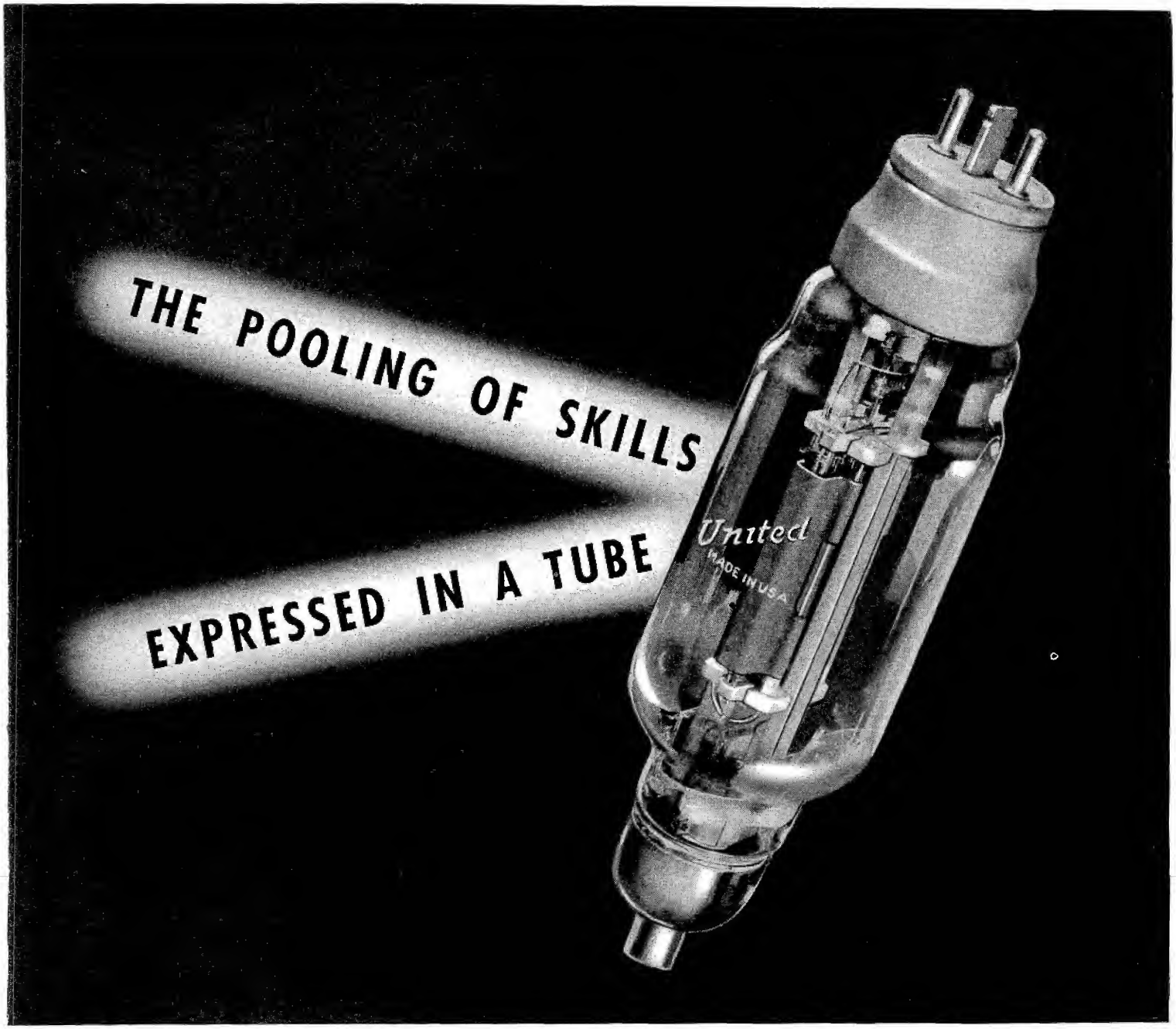


Figure 4
A double peak wave form that is characteristic of an overcoupled i-f amplifier system.



LONG BEFORE "UNITED" symbolized the might of Nations at War, the term possessed a vital significance in electronics.

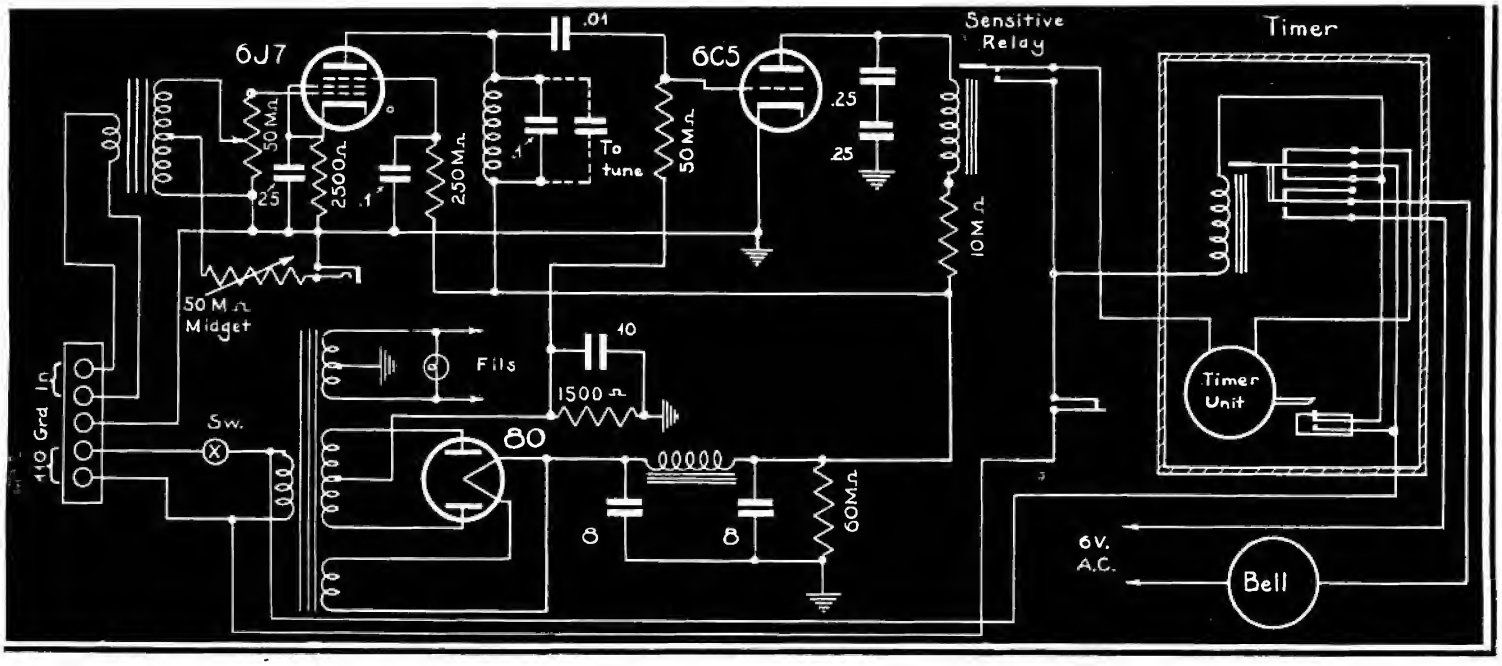
"United" expressed the vision of a company that undertook to pool, under one roof, the skills of distinguished technicians, engineers and craftsmen, specializing solely in transmitting tubes.

Under the scrutiny of these electronic specialists have come scores of transmitting tubes, built to a degree of precision, hitherto unknown.

Today, the products of "United" are performing flawlessly in key sockets in countless transmitting instruments of our armed forces. Tomorrow—tempered under the fire of war—"United" products of advanced technical design will meet the exacting post-war requirements of Radio Communications, Physiotherapy and Industrial Electronics. Look for the name "United" on each tube.

UNITED ELECTRONICS COMPANY

NEWARK NEW JERSEY



Circuit diagram of the alert system.

AN EMERGENCY ALERT SYSTEM

by DONALD PHILLIPS

MANY broadcasting stations today are compelled to monitor their key interceptor stations by radio to alert them to any emergency. One effective method of providing this alert service encompasses the use of an automatic monitor, particularly one that offers an audible alarm too.

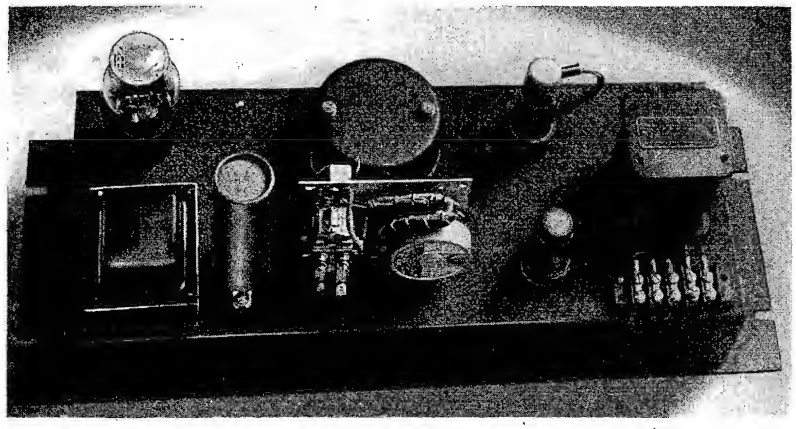
Such has the basis of design of a system recently developed by the Gates' engineers. This device can be attached to any radio receiver of standard design. It sets up a positive alarm system in the way of a loud ringing bell, when the actual signal is sent from the interceptor alarm station, discriminating at the same time, from all normal emissions from the interceptor station. In other words, the alarm operates only when the actual alarm is transmitted from the station.

Principle of Operation

As we know the signal sent out from the key station is a suitable audio tone, which lasts for several seconds. When this tone is received the operator is required to listen to the key station for further information, such as instructions to leave the air, turn off the tower lights, etc. Since all broadcasting stations must monitor their own program, the bedlam of two loud speakers operating at once from two different stations would be the cause of quite a bit of confusion. Not only would errors in instructions result, but a complete absence of data would prevail too, prompting serious consequences. This system consists of an amplifier in which all frequencies, other than the one to be received, are greatly attenuated.

In the alarm system, the filter in the plate of the first audio is tuned to the required audio-frequency tone. This filter is designed so that there is a drop-off of about 3 db on each side of this tone frequency down to several hundred cycles and up several hundred cycles. Thus the alarm will continue to operate even if the filter has a tendency to drift because of a leaky condenser or choke coil. Below and above these drop-off frequency ranges, the cut-off of the filter is quite sharp. The amplifier is linked to a sensitive relay operating only on the predetermined tone frequency. However, if the alarm were connected at this point, the bell would ring each time the tone or its harmonic from a voice signal were transmitted. Thus a time-delay system has been introduced. This prevents the operation of

(*Continued on page* 46)



A rear view of the automatic interceptor unit, showing the interceptor and timer units.

International Telephone and Telegraph Corporation

announces

that its Two Associate Manufacturing Companies

in The United States

INTERNATIONAL TELEPHONE & RADIO MANUFACTURING CORPORATION

and

FEDERAL TELEGRAPH COMPANY

have been merged

and the name of the corporation resulting from the merger is

Federal Telephone and Radio Corporation

located at Newark, N. J.

IT&T INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION, 67 Broad Street, New York, N. Y.

NEWS BRIEFS OF THE MONTH...—

CLAROSTAT RECEIVES "E"

The Army-Navy "E" excellence in production was awarded Clarostat Mfg. Co., Inc., of 285-7 N. 6th St., Brooklyn, N. Y., with ceremonies held in the Grand Ballroom of the St. George Hotel.

The presentation of the "E" was made by Major H. R. Battley, Regional Press Relations Officer of the US Army Air Force. The award was accepted by John J. Mucher, president of the company.

* * *

CANNON BONDING RING DATA

The Cannon Electric Development Company, Los Angeles, has just released a bulletin on its new bonding ring.

The Cannon Bonding Ring may be used wherever there is a need for bonding between electrical plug shell and wire shielding, and may be used with either flexible conduit coupling nut or cable clamp. The ring is used almost exclusively at present in bonding shielded radio and instrument circuits, but is adaptable to many other applications where a tight bond is required. Fits a variety of conduit nuts. Copy of Bulletin mailed on request.

* * *

WESTERN ELECTRIC HAS NEW PLASTIC

A new kind of plastic, "lignin," has been adapted by W. E. as a part of the Bell System's program of alternative materials. The material is a plastic fibre that takes the place of phenol fibre, widely used as an insulating material. Lignin was formerly a waste material, coming from sulphite, in the manufacture of pulp. Lignin—from "lignum," Latin for wood, comes in paper sheets conditioned to a definite moisture content, heated and subjected to high pressure, yielding a tough fibre board with—pound for pound—the strength of steel. Lignin fibre possesses good electrical characteristics, is less corrosive than phenol fibre, is readily punchable and has many of the other properties of phenol fibre board.

* * *

PHILCO IN CHICAGO WINS "E"

Award of the Army-Navy "E" to the Chicago division of Philco Corporation for outstanding achievement in war production has been announced by James T. Buckley, president. This is the fourth such award to Philco plants.

* * *

FOURTH PLANT FOR C-D

The opening of a fourth plant was recently announced by Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

* * *

AEROVOX ASKS JOBBERS TO RELEASE MICA STOCKS

The Aerovox Corporation of New Bedford, Mass., has sent out an urgent appeal to jobbers asking them to make existing mica capacitor stock available to Uncle Sam. Special inventory forms have been provided so that jobbers can simply, quickly and explicitly tabulate their available stock and send the information to the Army-Navy Communications Production Expediting Agency, Pentagon Building, Arlington, Va.

* * *

EDWARD WALSH DEAD

Edward James Walsh, an executive of Federal Telephone and Radio Corporation, of Newark, died suddenly recently at his home.

DOUG FORTUNE DIES IN PLANE CRASH

J. Douglas Fortune, Industrial Sales Engineer of Thordarson Electric Manufacturing Company, was fatally injured recently while piloting a plane near Chicago.

During the last eight years Mr. Fortune had been employed at the Thordarson Electric Manufacturing Company. Until 1939, he was research and development engineer. In 1939 he was promoted to the position he held at his death.

Mr. Fortune was the author of "Amateur Radio."

* * *

RAYTHEON CLOSES N. Y. REPLACEMENT SALES OFFICE

The Raytheon Replacement Sales Department has been transferred from New York to the factory at 55 Chapel Street, Newton, Massachusetts. A. E. Akeroyd is manager of this division.

* * *

ELLINGER'S TENTH YEAR AS AEROVOX REP

Fred Ellinger has just rounded out a decade with Aerovox condensers. Working out of his Ellinger Sales Company office in Chicago, Mr. Ellinger has been covering part of Wisconsin and Illinois, Indiana, Iowa and Nebraska.

He is a member of the Radio Old Timers' Club.

* * *

MURDOCK PHONE BOOKLET

An interesting 16-page booklet describing a wide variety of head phones has just been released by the Murdock Manufacturing Company, Chelsea, Mass. Among the phones described and illustrated are those used for aircraft, testing, hard of hearing, etc. Other Murdock equipment described include push buttons, telephone sets, telephone plugs, interlocking communication blocks, resistances and impedances, cords, etc.

* * *

RCA'S RADIO AGE

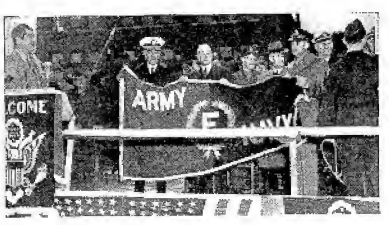
In the latest issue of the quarterly publication, Radio Age, published by RCA, appears features on the new RCA laboratories at Princeton; the use of sound today.

* * *

SYLVANIA EMPORIUM PLANTS WIN "E"

Rear Admiral Charles W. Fisher, Director of Shore Establishments, United States Navy, presented the Army-Navy "E" pennant to Sylvania Electric Products, Inc., in Emporium, at the recent ceremonies. Other notables present included Quentin Reynolds, as master of ceremonies, and Lieut. General J. T. McNarney, Deputy Chief of Staff, United States Army.

B. G. Erskine, president of Sylvania, received the plant flag from Rear Admiral Fisher.



UNITED ELECTRONICS BEGINS PRODUCTION DRIVE

A "top the top" drive to promote war production, cut down attendance losses, decrease rejections and increase the number of suggestions from workers was announced recently by R. H. Amberg, president of the United Electronics Company, Newark. The campaign is being handled by the War Production Drive Committee at the plant headed by Charles A. Rice.

Posters, suggestion boxes, cash prizes for practical ideas, awards for perfect attendance, pay roll insertions and educational techniques will be employed.

United Electronics Company manufactures transmitting tubes for the Army, Navy and under the Lend-Lease plan, and is 100 per cent devoted to war production.

* * *

J. G. PORTER HEADS G.E. PROMOTION UNIT

John G. Porter has been placed in charge of all sales promotion activities of the Transmitter and Electronic Tube Divisions of G. E. Radio, Television and Electronics Department, Schenectady, N. Y. He formerly was with the G. E. publicity department.

* * *

I.T.T. MERGER AND NAME CHANGE

The two associate manufacturing companies of International Telephone and Telegraph Corporation in the United States, International Telephone and Radio Manufacturing Corporation and Federal Telegraph Company, have been merged. The name of the corporation resulting from the merger is Federal Telephone and Radio Corporation, Newark, N. J. From now on the business will be conducted under the new name.

International Telephone and Radio Manufacturing Corporation has been engaged primarily in the telephone end of the business making automatic telephone central office and private branch exchange equipment, telephone instruments, Selenium Rectifiers, Intelin materials, etc.

Federal Telegraph has long been a major manufacturer of radio transmitters and receivers and radio transmitting tubes. It manufactures radio broadcasting and point-to-point radio stations, a complete line of marine and aircraft radio equipment, radio direction finders for ships, and radio aids to aerial navigation.

In cooperation with the Civil Aeronautics Administration of the Department of Commerce, I. T. & T. manufacturing subsidiaries developed and are manufacturing and installing the system of airplane radio instrument landing which is now in use at a number of the larger airports in the United States.

* * *

S.M.P.E. FALL MEETING IN N. Y.

Sound control and recent developments in sound tracks were among the many interesting topics discussed at the annual fall meeting of the SMPE in the Hotel Pennsylvania in New York City recently. H. Burris-Meyer of Stevens Institute of Technology discussed sound control in the theatre, while Clyde R. Keith of Electrical Research Products division of Western Electric in Hollywood, discussed recent

(*Continued on page 26*)

TUBE REBUILDING PROGRAM

Much of the material extracted from tubes requiring rebuilding, can be reclaimed. Above we see quite a collection of such pieces, that have gone through the necessary procsses that make them suitable for reuse.

be re-recruited for one purpose or another. There is no doubt that there is need for some critical material in the rebuilding of tubes, but every effort is made to reduce this requirement to a minimum.

Transportation Problems

A subject which today invites maximum attention when considering the program of rebuilding is that of transportation. Too much stress cannot be placed upon this. Not only is it imperative that the shipping crate originally used to house the tube be used again, but the same precaution that would be used to pack a new tube, should be used in repacking the old. At all times during handling, the tube should be kept in a vertical position with the filament end up. This may sound like an odd rule to follow when the tube to be returned has, let us say, a broken filament or a damaged grid. It must be remembered, however, that every effort is being made today to salvage every bit of critical material, and thus there is no reason why additional damage should be incurred. At no time should crated tubes be piled on top of one another. It must be remembered that the weight of an 891-R tube, for instance, with its air-cooled radiator, is some ninety pounds in crated form. Although most stations have the original cases in which these tubes were sent, there are some, who because of variety of conditions, such as moving, limitation of space, etc., have discarded these cases. They should make every effort to duplicate the originals before returning tubes.

Extending Filmanet Life

Since these tubes are of the tungsten filament type, longer life can be obtained if the filaments are operated at less than rated voltage. This move should prove quite helpful in further extending the life of the rebuilt tube. Of course, this practice is one that is recommended for the tubes that are new or rebuilt. It is explained in various tube folders, and was given further impetus at the Ohio State Conference held last March, by Charles W. Singer, who is at present with the Signal Corps, but who was then the technical supervisor at WOR. Mr. Singer showed that the 5% reduction in filament voltage doubled the life of the tube. The exact percentage of reduction was predicated on the type tube used and the characteristic transmitter effect. The fact that the FCC recently approved a 1 db reduction in radio power, which, of course, is predicated on lower filament voltage and a decrease in percentage of antenna current rise, seems to give credence to the use of the reduced filament voltage.

All illustrations are presented through the courtesy of RCA.

NEWS BRIEFS

(*Continued from page 24*)

development in sound tracks. The use of intercommunications was also featured in the report of the engineering committee.

* * *

DECADE CONDENSER DATA

Frequency characteristics of decade condensers are analyzed effectively in the latest issue of the General Radio Experimenter, No. 5, Volume 17. Among the problems discussed are dielectric polarization, residual impedance, condensers in parallel, etc. The study, prepared by R. F. Field, is well illustrated.

* * *

A-F AND R-F AMPLIFIER INFORMATION

The May and July issues of the Aerovox Research Worker contain data on high efficiency r-f amplifiers and a-f amplifier checks. In the June issue of this monthly engineering release appears a study of a-m. The material in each of these four-page bulletins is extremely well written and should prove useful to both engineer and executive.

* * *

STROMBERG-CARLSON SOUND BOOKLET

A new booklet entitled "Tell It To Sweeney," has been published by Stromberg-Carlson. The booklet shows how economies can be introduced by war plants by the use of "straight line communication," instead of using only the telephone.

Copies of the booklet are available from A. F. Schifino, manager of the sound system division, Stromberg-Carlson Tel. Mfg. Co., 100 Carlson Road, Rochester, New York.

* * *

MANDERNACH NOW G. E. REPLACEMENT TUBE S-M

H. J. Mandernach has been appointed sales manager of the Replacement Tube Section of General Electric's Radio, Television and Electronics Dept., at Bridgeport, Conn.

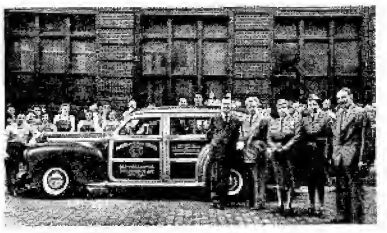
In his new position, Mr. Mandernach will be responsible for replacement sales of all types of electronic tubes handled through distributors, including tubes for radio receivers, transmitters, industrial control and power applications.

* * *

JEFFERSON-TRAVIS GIVES AMBULANCE

A fully equipped station wagon-ambulance for the Disaster Squad of the New York Chapter was given to the American Red Cross by 200 members of the Jefferson-Travis and Union Aircraft organizations, New York City. Capt. Scully, Major Conan and Lt. Baldwin (shown in center of photo) accepted the gift for the Red Cross.

(*Continued on page 27*)



NEWS BRIEFS

(*Continued from page 26*)

INSULINE EXPANDS

The Insuline Corporation of America has acquired larger quarters in a modern factory building, that will be known as the Insuline Building. It is located at 36-02 35th Avenue, Long Island City, New York.

Catalogues describing the complete line of Insuline products may be had by writing to the new address.

* * *

DUBLIFE GAGES MOVES

United Precision Products Company, manufacturers of Dublife Reversible "Go" and "No Go" Gages, "Uppco" Finish, and American Gage design gages, has moved to 3524 West Belmont Avenue, Chicago, Ill.

* * *

MILLER RADIO CHANGES NAME

Miller Radio and Television Research Bureau, of which G. Wilson Miller is president, will hereafter be known as the Miller Radio & Electronic Laboratories. The laboratories has its headquarters at 2 Chester Terrace, Hastings on Hudson, N. Y.

* * *

NEW TYPE CALENDAR

A unique 1943 calendar is being offered free by the Frederick Post Co., Chicago, Ill.

This calendar, 15¾ x 24½, has 52 weekly sheets in big black numerals easily read from any part of a drafting room. A section of technical data for the engineer and draftsman is also included, containing charts on wire and sheet metal gages, screw threads, etc.

To obtain, mail in request on your business letterhead.

* * *

INDUSTRIAL CONDENSER DISPLAY

Industrial Condenser Corp. of Chicago has issued a new counter display for use by their distributors. The display stands 18 inches wide by 20 inches high with sixteen representative types of condensers mounted on the board.

* * *

JENSEN NEEDLE DISPLAY

Jensen Industries, Inc., 737 North Michigan Avenue, Chicago, have produced a new counter display that occupies a counter space of 4½" x 11½". It is 13½" in

(*Continued on page 28*)

NEWS BRIEFS

(*Continued from page 27*)

height, and contains a "baker's dozen" of Jensen long-life phonograph needles.

* * *

ROBINSON NOW N-U SALES HEAD

J. H. Robinson has been appointed sales manager of The National Union Radio Corp., succeeding Henry A. Hutchins, who left recently to accept a commission as a lieutenant-commander in the United States Naval Reserve.

* * *

ROYE IN SIGNAL CORPS

Marvin Roye, late of the Roye Sales Agency, representing Hallicrafters in the metropolitan area around New York, is now Lieutenant Roye of the Signal Corps.

* * *

VINYLITE PLASTICS FOR WIRE

The Halowax Products Division of Union Carbide and Carbon Corporation, 30 East New York, N. Y., has just released a new 12-page booklet, "Vinylite Plastics for Wire and Cable Insulation." The booklet reviews the advantages of Vinylite resin compounds for wire and cable insulation from the standpoints of installation, service, and safety.

The booklet describes the practical advantages of wire and cable insulation made from Vinylite plastics and contains tables indicating the physical and electrical properties of the compounds, and typical applications.

Copies are available by sending in request.

* * *

DAVIS-SOLENOIDS ENGINEERING DATA

Two new laminated solenoids, the 2861 pull type and 2923 push-pull type, are described in a bulletin released by Dean W. Davis & Co., 549 W. Fulton St., Chicago, Illinois.

They are particularly designed for specification by engineer-designers for hydraulic valves and general industrial purposes. Maximum magnetic force for given electrical input is effected by design, laminated frame and plunger and other features.

Coils may be paper section wound, cloth-taped and treated to make impervious to cutting oils and coolant. Installation is easy for either direct or remote control, and quick short thrusts. For a-c/d-c, and all voltages.

Bulletin may be had free by addressing the manufacturer.

* * *

RAY NOW V-P OF A.T.T.

John H. Ray was recently elected vice-president and general counsel of the American Telephone and Telegraph Company.

Mr. Ray has been counsel of the company since 1936. During nearly 20 years of service with the Bell System he has also served as vice-president and general counsel of the Western Electric Company.

* * *

HUNGERFORD HEADS AIRCRAFT DEVELOPMENT UNIT

Dan C. Hungerford has been elected president and general manager of Aircraft Parts Development Corporation, Summit, New Jersey.

Until recently, when he resigned to help organize the corporation which he now heads, Mr. Hungerford was vice-president and a director of the Elastic Stop Nut

Corporation, Union, New Jersey. Prior to that, he was president of the Standard Manufacturing Company, Corning, New York.

* * *

RMA MEMBERSHIP INCREASES

The largest membership since 1931 is now enrolled in the RMA. There are now 150 members as compared to 109 last year.

Data on the personnel and products of the present members appear in the latest 1942-43 directory just released.

* * *

HAGEMAN NOW WESTINGHOUSE ENGINEERING MANAGER

Dr. A. M. Hageman has been appointed general engineering manager of the Westinghouse & Manufacturing Company Lamp Division, Bloomfield, N. J.

In his new position, Dr. Hageman will supervise all development and engineering activities involved in the production of lamps and electronic devices. He formerly was in charge of lamp engineering.

* * *

SYLVANIA WINS DIRECT MAIL AWARD

The Radio Division of Sylvania Electric Products, Inc., was recently given the Direct Mail Advertising Association annual citation as one of the fifty direct mail leaders of the country for the past year. The award was based on the successful use of wartime themes in direct mail and sales promotion items, and was receeived by Henry C. L. Johnson, advertising manager.

* * *

KARL MILES NOW LT. COMMANDER

Lt. Karl Miles of the Navy and formerly chief engineer of the Hallicrafters, Inc., Chicago, is now a lieutenant commander.

Lt. Commander Miles is now in charge of inspection of aircraft radio and electrical goods for the Navy.

* * *

ELECTRON MICROSCOPE AT CHEMICAL CONFERENCE

The National Chemical Exposition and Industrial Chemical Conference, November 24-29, at Chicago, will feature the first symposium on the electron microscope. Dr. V. K. Zworykin, associate director of RCA Laboratories, will discuss "The Electron Microscope in Relation to Chemical Research." And for the first time, the RCA Electron Microscope will be displayed.

* * *

GALVIN TO AID SIGNAL CORPS

Paul V. Galvin, president of the Galvin Manufacturing Corp., Chicago, and head of the RMA, has accepted a temporary ninety-day appointment as a technical advisor to Major General Coulton, United States Signal Corps, who is in charge of production for the Signal Corps.

* * *

CORNELL U. ALUMNI ELECTS GUBB PRESIDENT

Larry E. Gubb, chairman of the board of directors of Philco Corporation, has been elected president of the Cornell University Alumni Association.

Mr. Gubb was graduated from Cornell in 1916 with the degree of Bachelor of Science.

* * *

BELT SURFACING DATA

A twenty-four page booklet on "Wet-Dry Belt Surfacing" has just been issued by the Porter-Cable Machine Co., Syracuse, N. Y.

This booklet reveals the departments in which belt surfacing saves time, money

(*Continued on page* 42)

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President — RCA BUILDING, 30 Rockefeller Plaza, New York, N. Y. — GEORGE H. CLARK, Secretary

VWOA officers, left to right, standing: P. K. Trautwein, chairman finance committee; Fred Muller, George Clark, H. H. Parker, W. S. Fitzpatrick; left to right, seated: A. J. Costigan, William J. McGonigle and J. R. Poppele, chairman scholarship committee.

PERSONALS

WILLARD WILSON, our Resident Agent in Delaware, has accepted a Captaincy in the Air Corps and is now serving as instructor of embryo Air Corps radiomen at an air station in Florida. . . . Our good friend and well wisher, John F. Rider of "Rider Manuals" fame, is likewise serving in the Army as a Major stationed at Camp Murphy in Florida. . . . Wonder whether George Street, chairman of our Honolulu chapter will arrange a "LUAU"—Hawaiian for feast—in February of 1943 simultaneous with our Cruise in New York? We hope so, George, and let's know the place so we can send a message. . . . Happy to receive a postcard from Major David Talley, U. S. Army Signal Corps, now stationed overseas. Major Talley has been of great assistance on many occasions in VWOA affairs. . . . We think Ray Meyers should drop us a line from the San Francisco area. You may remember Ray accompanied Wilkins in the submarine Nautilus up North Pole way. He was a retired Chief Radioman of the U. S. Navy and we believe he has returned to the service of his country. Let's know, Ray. . . . Congratulations to J. Harrison Hartley, Chief of the Radio section of the Bureau of Public Relations of the Navy Department, on the recent arrival of twins. . . . Our congratulations to a real oldtimer, Robert Woolverton, upon his elevation to the post of Colonel in the U. S. Army Signal Corps. Col. Woolverton has served as chairman of our Omaha and Seattle chapters and is now stationed overseas. . . . It was our impression that James Chapple of the FCC originally joined our Association when the Los Angeles Chapter was formed, but we note in the February 1936 issue of this magazine that we noted his attendance at the Honolulu chapter's dinner and that he then joined our Association. Mr. Chapple is now in charge of the Los Angeles district of FCC. . . . John C. Christianson, formerly in charge of the long wave station of the American Telephone and Telegraph Company at Rocky Point, N. Y., has returned to the service of his country as a Chief Radioman in the United States Navy. J. C. C. has served as chairman of our Port Jefferson chapter these many years and when last seen in Port Jefferson he proudly wore his Chief Radioman's uniform with an armful of "hash" marks. . . . We had a recent call from Dick Nebel, recipient of our Marconi Memorial Scroll of Honor and now studying at home under our Association's scholarship in the Capitol Radio Engineering Institute, Home Study Division. Dick stated he is enjoying the course and finds it most profitable. We learn from other sources that he is doing a grand job of furnishing crystals to the Army Signal Corps and is training a group of young women to assist him in grinding crystals with a minimum of equipment in their own homes. Since the age of three, Dick has been paralyzed in both legs. Congratulations, Dick, and keep up the good work. . . . Charles Singer, transmitter supervisor of WOR, New York, recently accepted a Government appointment. . . . We learn from Jack Poppele, chief engineer of WOR, that Robert Barkey, our first Marconi Memorial Scholarship graduate of RCA Institutes, is doing a fine job in the engineering department of WOR. . . . Hal Styles, chairman of our Los Angeles Chapter, now conducts a column, "Keep Smiling," in the Los Angeles weekly publication, "Radio Life." In addition, Hal continues active as a broadcaster with a daily half-hour program over KFWB in that city. . . . Have you paid your dues? Just take a quick glance in your wallet and if you cannot find a 1942 membership card then you owe the Association a year's dues. Please save us the trouble of mailing you another statement. Thank you.

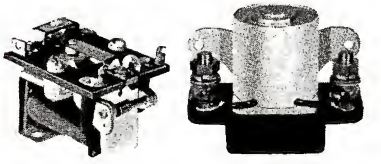
A recent call from "Bob" Frey, supervisor of radio for the Bull Steamship Lines, gave us the sad news that he had been advised by the authorities that Radio Officer William Helmbold was missing by enemy action. It was the pleasure of our Association to accord recognition in the form of a Marconi

(*Continued on page* 43)

Relays BY GUARDIAN · · · SERVE ALL FRONTS!

★ Yuletide joys of '42 will not include the many electrical gifts which brought us cheer, and ease, and comfort in other years. Relays by Guardian have marched on from peacetime industry to the firing lines of war. Doing war jobs in many ways . . . in planes . . . in tanks . . . in communications . . . in bomb releases and gun controls. Wartime jobs which Guardian anticipated and planned long before "Pearl Harbor".

But, while thinking, building, and engineering the tools of war today, Guardian again is looking *ahead* to peacetime applications of Relays, Solenoids, Electrical Controls of all kinds. If you are making plans for "after-it's-over", ask our engineers to plan with you. Write to Guardian. Our wartime experience can help you build better products for the future.



CONTROLS FOR ANY PURPOSE... *ranging from 150 watts to 1000 amps . . . from tiny relays weighing less than an ounce . . . to big, rugged two-pound contactors.*

GUARDIAN ELECTRIC

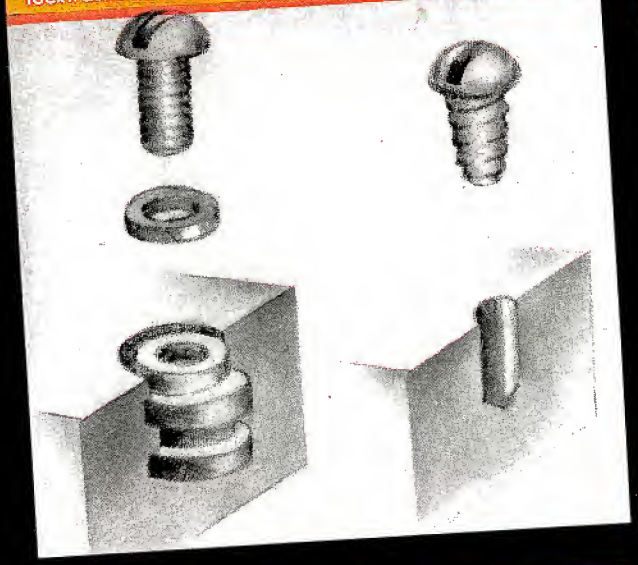
1623 WEST WALNUT STREET CHICAGO, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

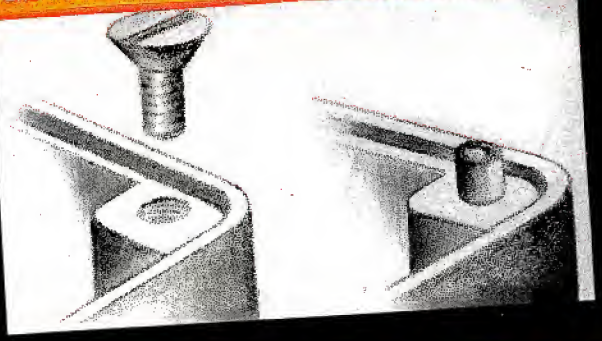
In the Battle of Design

A waste of material or machine time in engineering design today is as damnable as sabotage. The battle of design will be won by refinements in existing components as well as by new inventions. Savings in small things add up . . . to big things. Here are some examples:

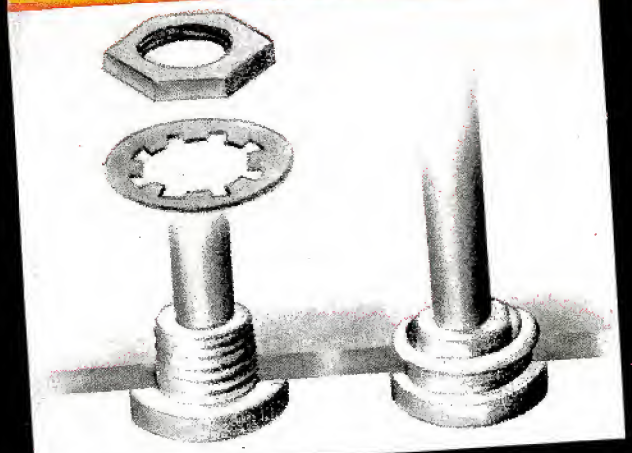
One of our engineers changed the construction of a plastic assembly from brass insert + lockwasher + brass screw to steel PK screw only. Approved by the Army, the savings represented 1,000,000 inserts and lockwashers.



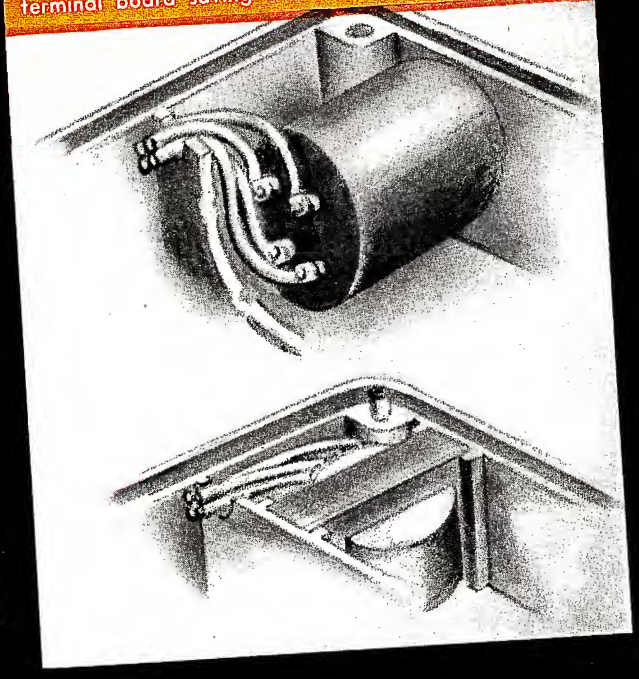
In die cast structures, covers and nameplates were held on by screws. A UTC design modification added a round projection in the casting, which is spun over to hold the plate or cover. Saving: over 2,000,000 screws and lockwashers . . . over 2,000,000 tapping operations.



One UTC design eliminated a threaded shank, lockwasher and nut by changing to a spun-over shoulder on the shank. Saving . . . 150,000 lockwashers and nuts . . . 150,000 threading operations.



This structure employed a cased transformer fastened to a compartment wall with screws. A changed design permitted potting the transformer directly in the compartment. Saving . . . 1,000,000 terminals . . . 300,000 screws . . . 400,000 aluminum cans . . . plus terminal board saving and reduction in overall size.



These savings *added up*. Small in themselves . . . slight for each individual unit . . . their total is impressive. Today we need all possible savings . . . even those which seem impossible at first. Review your designs for Savings for Victory.

UNITED TRANSFORMER CO.

150 VARICK STREET ★ NEW YORK, N. Y.

EXPORT DIVISION: 100 VARICK STREET NEW YORK, N. Y. CABLES: "ARLAB"

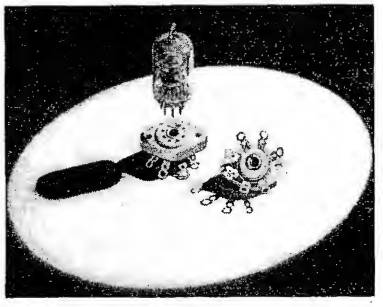
THE INDUSTRY OFFERS

JOHNSON MINIATURE SOCKET

A miniature socket, 267, featuring government grade G Steatite insulation, has been produced by E. F. Johnson Company, Waseca, Minnesota. The newcomer is designed for use with the 9000 series and miniature series tubes including RCA 1S4, 1S5, 1T4, 1R5, etc.

Contacts are phosphor bronze, heavily silver plated, and are self-aligning. Other features include orientation of contacts for minimum capacity effect and a center shield for grounding to chassis. Steatite insulation is glazed top and sides and the bottom wax impregnated.

For additional information write for catalog 967B.



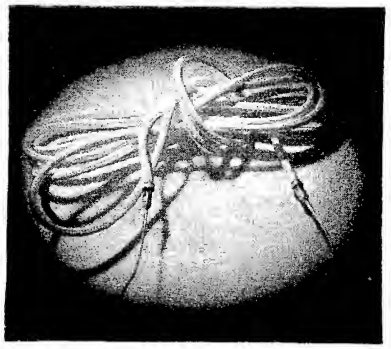
* * *

GLASS-INSULATED FLEXIBLE HEATING ELEMENT

The glasohm flexible power resistor made by Clarostat Mfg. Co., Inc., 285-7 N. 6th St., Brooklyn, N. Y., is now available in any length, by the inch or foot.

In the Glasohm construction the resistance wire is wound on a fibre-glass core and is protected by a fibre-glass braided covering. The fibre-glass while providing the desirable properties of unbreakable and virtually indestructible glass, is almost as flexible as silk, so that the unit can be readily bent and compacted to fit snugly about parts to be heated, or again jammed into very tight spots, in either case providing an efficient heating means. Wattage ratings are from 1 to 4 watts per body inch depending on the application. Operating temperatures up to 750° F.

Glasohm heating elements are now found in electric soldering irons, temperature-controlled ovens for oscillating radio crystals, the heating of aviation and marine instruments, etc.



PHOTOCOPY MACHINE

A photocopy machine which produces copies similar to photostats, the actual size of the original, of anything written, typed, printed, drawn or photographed, has been produced by the American Photocopy Equipment Company, 2849 North Clark Street, Chicago, Ill.

The machine is reported to produce copies without a dark room and without skill or technical knowledge. Copies of material up to 18 x 22 inches are possible. The reproduction is said to be available in less than three minutes. The instrument also makes copies directly from blueprints.

* * *

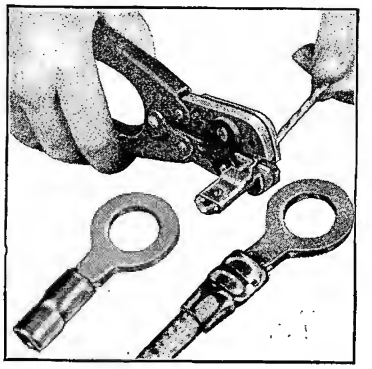
"HAND-DIE" INSTALLATION TOOL

Three crimps can be made at one time by a new "hand-die" installation tool designed for use with Aircraft-Marine "diamond grip" solderless insulation support terminals.

This new tool, made by Aricraft-Marine Products, Inc., 286 N. Broad St., Philadelphia, Penn., is so designed that unskilled workers can achieve production line efficiency without the usual long training period. An insertion gauge automatically positions the terminal; the crimping jaws for both wire and insulation are in reality dies of tool steel adjustable to accommodate various insulation and wire diameters. There is a 15 to 1 leverage on the "self-opening" handles.

Army and Navy wire sizes are clearly marked on the tool which may be quickly made left or right handed as needed.

For further data, ask for bulletin 18.

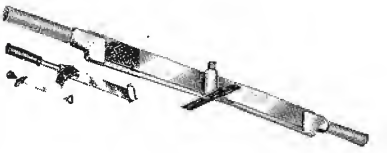


TORQUE MEASURING WRENCHES

The P. A. Sturtevant Co., of Addison, Illinois, has developed a complete line of torque measuring wrenches comprising 8 models. They range in size and capacity from small instrument building wrenches of a few inch pound capacity to great two handled torque wrenches of 7200 inch pound capacity.

These wrenches are being used for gauging or measuring tortional force, as when equalizing the set of screws or nuts by tightening to a predetermined torque, or for measuring the frictional drag in motors or mechanisms.

All are of the flat tapered beam type with fixed end and top scales.



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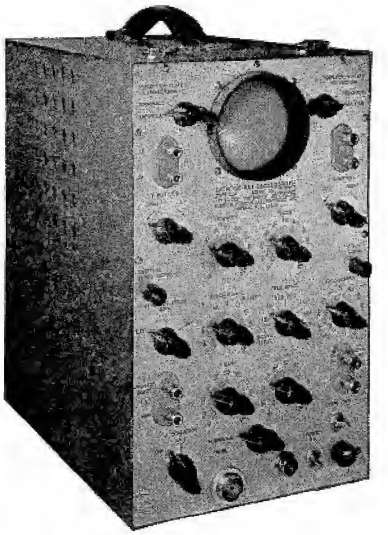
OSCILLOGRAPH FOR EXPANDED FREQUENCY RANGE

A new oscillograph, type 224, is now offered as a standard instrument by Allen B. Du Mont Laboratories, Inc., Passaic, N. J. It features the Y-axis or vertical deflection response which is uniform from 20 cps to 2 million cycles. It has a comparably faithful square and sinusoidal wave response. The X-axis or horizontal deflection amplifier has a uniform characteristic from 10 cps to 100 kilocycles. Both amplifiers are said to have distortionless input attenuators and gain controls.

The widest variety of signal input connections are said to be available. In addition to the conventional amplifier connections, signals can be applied directly to the deflection plates of the 3-inch cathode-ray tube, when it is desirable, by means of terminals at the front panel of the unit. The Y-amplifier has an input connection for shielded-cable test probe type 242A,

(*Continued on page* 36)



THE ROCHESTER FALL MEETING

(*Continued from page 9*)

ment hasn't permitted an influx of any complexities, he explained further. Thus it would be ridiculous to maintain that simplification is new or that no further simplification can be introduced. However, Mr. Farrell said, it is doubtful, unless the service requirements are completely changed, that the magnitude of simplification would be substantially reflected in increased production.

In production methods, pointed out Mr. Farrell, we have a factor which rates consideration, for the job of ordering, routing, planning, making the most of available facilities, can account for the success or loss of a project. One of the gravest problems has therefore been the expansion of the organization which bridges that gap between the completed drawing and the delivery of the finished article, explained Mr. Farrell.

If we grouped all the foregoing factors and handed them over to an ideal production organization with adequate manpower, we still couldn't guarantee production. For current production, said Mr. Farrell, is limited chiefly by the supply status of critical materials while the quantity of apparatus delivered is governed by the allocation of these materials in certain components. Whether the shortage of basic raw material is the cause, or the cause is a want of insufficient facilities, he explained, the reason is unimportant, because in a large measure the situation is beyond the control of the radio industry. It is a material problem that *must* be solved, he pointed out.

The material problem involves not only a program of substitution, but rather one which should provide for alternates. Designers should provide an alternate list and allow production and planning departments a free choice depending on current knowledge of material availability, explained Mr. Farrell.

Current procurement experience shows that zinc is more plentiful than nickel or cadmium; common steel can be obtained more readily than the alloy steels or aluminum, and aluminum sheet is more readily obtainable than aluminum bar, rod or extruded stock, said Mr. Farrell. There is, of course, no guarantee that the situation will be the same several months from now, but the course of action for the present is clear. Mr. Farrell showed that over 2,000,000 pounds of aluminum were saved by the use of alternate steel.

Our friends, steatite and mica capacitators, two tough customers in any procurement program today, were also discussed by Mr. Farrell. Although the supply of steatite has increased during the past months, there still isn't enough to go around. In this instance, while the generous application of alternates has helped considerably, the most satisfactory answer to the problem was more steatite. Additional facilities could not be added, explained Mr. Farrell, and thus an alternate material, which is in this instance the new material, has at the present time solved the problem, according to Mr. Farrell. Its talc content shows it has steatite properties and its shrinkage is the same as steatite. The difference is that this body contains no felspar. The frit is a synthetic compound, explained Mr. Farrell, which is subject to precise control, and is therefore uniform.

The mica capacitor may be well on its way to solution, according to Mr. Farrell, thanks to a WPB sponsored program, on the application of oil-impregnated hermetically sealed paper capacitors.

One of the most interesting exhibits on the alternate list shown by Mr. Farrell was a unique wire-wound resistor which took the place of a vitreous enamelled resistor. This alternate unit used nichrome ribbon welded to phosphor bronze wires which served as taps and supports, and weighed almost one-half as much as the other unit.

In conclusion, Mr. Farrell reiterated and stressed the fact that the material situation is the major obstacle to increased production and as such it rates preferred attention from the engineers of the industry.

A few of the many components for which alternates have been designed at General Electric. Mr. Farrell is shown with a tuning inductance in which mycalex has been substituted for steatite and aluminum.

Rice's Discussion on Production Tests

Production test methods are more important today than ever before. Such methods involve careful thought and planning not only for the completed unit itself, but for the various pieces used in the fabricating of that unit. In a paper presented by Harry E. Rice of the Sperry Gyroscope Co. on this subject, a program used for such quality testing was effectively outlined. It must be remembered, said Mr. Rice, that the use of the dollar value of equipment as a gauge for the use of suitable test methods, a procedure used in civilian practice, cannot apply to military production. It is just as essential that the same care be exercised in testing a small unit as a large and more expensive one.

Because of the lack of skilled labor and the need for accuracy and speed, all tests developed must, of necessity, be simple and fool-proof, pointed out Mr. Rice. A worker must be able to tell at an instant if the object of the test does or does not pass. It is not up to him to determine the cause of trouble. That is up to a more experienced workman, said Mr. Rice. Accordingly, no limitation within reason is put on a fixture design engineer, except that the final equipment, however, complicated in its construction, must be simple to operate and provide a clear, positive indication as to whether or not the object under test is acceptable, explained Mr. Rice.

Individual Tests

As pointed out previously, individual components are tested carefully. Resistors, for instance, under 100,000 ohms are checked up on a standard percent limit bridge. Where resistors are above 100,000 ohms, they are checked on a megohm bridge. Other tests include those for capacitors, tubes, r-f conductors and transformers, power transformers and wiring.

Wire Testing

A unique testing method is used to check wires in a cable. To be sure that no crosses or wrong break-out points have been made, a pilot light system is

(*Continued on page 39*)

THIS is more than a war of mechanical monsters clashing in the night . . . more than a war of production.

It is a war for markets—*your* markets! The Axis wants your business—wants to destroy it once and for all.

With so much at stake, there is no doubt you will want to do everything you can to meet this Axis threat. Two ways are open: Speed production and put 10 percent of your income into WAR BONDS! The only answer to enemy tanks and planes is *more* American tanks and planes—and your regular, month-by-month purchases of War Bonds will help supply them. Buy now *and keep buying.*

THE GOAL: 10% OF EVERYONE'S INCOME IN WAR BONDS

When you install the Pay-Roll War Savings Plan (approved by organized labor), you not only perform a service for your country but for your *employees.* Simple to install, the Plan provides for regular purchases of War Bonds through voluntary pay-roll allotments.

Write for details *today!* Treasury Department, Section R, 709 12th St. NW., Washington, D. C.

EVERYBODY EVERY PAYDAY 10%

War Savings Bonds

This space is a contribution to Winning the War by

COMMUNICATIONS

Battle Flags!

All of us at the Hallicrafters are both proud and humble to have important assignments in defeating America's enemies.

That our efforts have justified the award of the famous Army-Navy "E" flag is a great honor. We shall keep it proudly flying.

all of the hallicrafters

THE INDUSTRY OFFERS...—

(*Continued from page 33*)

supplied with the instrument. This reduces input capacitance and eliminates stray pickup. All high-voltage electrolytic condensers are eliminated from circuit.

It operates on 115 volts, 60 cycles a-c.

* * *

VITROHM STRIP RESISTORS

For applications in aviation, radio, and installations where space limitations and high unit space watt ratings are important requirements, Ward Leonard have produced vitrohm strip resistors.

These resistors employ a strong, flat refractory core for the resistance wire winding. Terminals are mechanically banded and spot welded in position on the core; the core and winding are then sealed in a fused on vitrohm enamel.

Each unit is fitted with a self-sustained mounting bracket and spacer. These spacers and end brackets are riveted to metal strips that extend through the core providing additional heat radiating facilities.

Several sizes of Vitrohm Strip Resistors are available, ranging from 1½ to 6 inches in length with ratings of 30 to 75 watts.

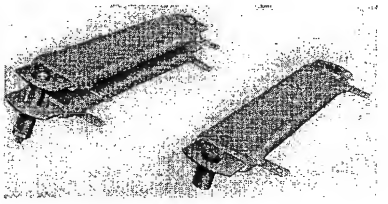
Bulletin 23, available on request gives dimensions, ratings, ohmic values, and other information.

Small pressed steel power rheostats having a large number of steps and ample current carrying capacity, have also been developed by Ward Leonard.

These rheostats are 4 inches in diameter with as many as 43 steps of control and are rated for 100 watts. Spacings through air and creepage distances between parts of opposite polarity and between current carrying and grounded parts meet the requirements of AIEE, NEMA and Underwriters' Laboratories for 300 volt service.

The rheostats also feature balanced contact arm, "dead" shaft construction, copper graphite contact shoes and front or back-of-board mounting in single and multiple assemblies.

Bulletin 69 contains full data.



* * *

RCA RELEASES NEW TUBES

New tube types for use in connection with WPB rated orders, have been released by RCA. They are 1C21 (gas-triode), 2AP1 (high-vacuum cathode-ray tube), 5R4-GY (full-wave high-vacuum rectifier), 6AG5 (r-f amplifier pentode, miniature type), 6J6 (twin triode, miniature type), 934 (vacuum phototube (2-15/32" long x 23/32" in diameter), and 935 (vacuum phototube, ultraviolet-sensitive type).

The 1C21 is designed for use primarily as a relay tube. The discharge can be initiated with a very small amount of energy applied in the grid circuit. It is similar to the type OA4-G but is more sensitive. The 2AP1 is similar to type 902 except that it has separate leads to all deflecting electrodes and the cathode em-

(*Continued on page 42*)

RELAYS

(*Continued from page* 12)

contacting-faces is avoided. The relay shown is a double pole style, whose general application is the control of two circuits having independent power supplies. Its electrical capacity is 10 amperes at 115 volts and 5 amperes at 230 volts. The motor rating of each circuit in which this relay might be used is one horsepower repulsion-induction, or ½ horsepower spit phase.

For blackouts and other defense applications, an unusual mercury type relay has been recently designed. In this unit, the circuit is made and broken in a hermetically sealed chamber under hydrogen pressure. The relays cannot be affected by dust, dirt, moisture, corrosion or are they subject to arcing or pitting contacts. They have low contact resistance and are explosion proof. In operation, when the coil is energized, the plunger is pulled down. This displaces the mercury, causing the mercury to rise in the steel chamber until contact is made with the electrode. This unit has a capacity of up to 30 amperes.

Another type of mercury relay of similar hardy structure has been designed for time relay work, Figure 10. It is for recycling action as well as delaying action. In this unit, the tube is filled with an inert gas which cools and quenches the arcing. A hermetically sealed mercury time relay that is unaffected by the elements is used. The capacity of this unit is up to 75 amperes, with solenoids available for any voltage or frequency.

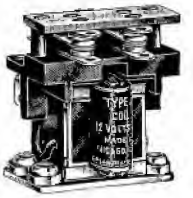
Still another type of mercury relay is illustrated in Figure 11. This is known as a plunger type, and features but one moving part, with a mercury-to-mercury break. It operates in any position within 45 degrees of the vertical, up to 30 amperes or one horsepower a-c rating. In operation, the plunger within a glass tube is pulled downward when the coil is energized. This action displaces the mercury in the tube, and floods the contact, which closes the circuit. When the coil is de-energized, the plunger immediately floats to the top of the mercury and opens the circuit instantly.

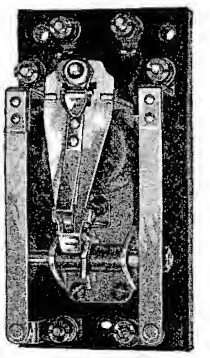
Aircraft Communication Relays

In aircraft communications tremendous strides in relay design have taken place . . . strides that can be well classified as amazing, considering the conditions under which these devices must work. For instance, the relay shown in Figure 12 has contacts that will make or break 30 amperes at altitudes up to 40,000 feet. The coil, contacts and plunger are enclosed in a dust-tight housing, that is corrosion proof, and is said to meet the 200 hour salt spray tests that is required by Government agencies. The relay will operate in an ambient temperature range of from 95° C to 40° C, and will withstand 95 per cent humidity at 75° C on a 48 hour test.

Another aircraft relay with features

(*Continued on page* 38)





Figures 16 (left) and 17 (right)

At left, a G-M Lab. relay for d-c use at high altitudes, with a contact pressure of 35 grams. At right, a Struthers-Dunn, ratchet type sequence relay.

RELAYS

(Continued from page 37)

such as double break contacts capable of handling up to 1,000 volts d-c, is shown in Figure 13. In Figure 14 appears a 400 cycle, 26 volt aircraft relay. It is lightweight as are the others. The relay may be used to provide a positive alarm signal in case of failure of the 400-cycle generator, or of the control circuit. It is operated by the control current, and holds its break contact springs open as long as the current continues to flow. Interruption of the current releases the relay, which closes the alarm circuit through its contacts. The relay is entirely non-positional, and operates under the typical extreme vibration conditions met in plane service

For latching relay service in aircraft, we have the type illustrated in Figure 15. A feature of this relay is that it locks mechanically in either position, so that only momentary current need be applied to the coils. The relay is a four pole, double-throw device, with a maximum rating of five amperes per contact. It is non-inductive, and available for d-c or a-c.

A relay for direct current applications at high altitudes and under high humidity conditions, as well as the high accelerations and vibrations encountered in aircraft installations is shown in Figure 16. The contact pressure is but 35 grams, while its contact capacity is up to 20 amperes at 30 volts d-c.

Ratchet Type Sequence Relays

Ratchet type sequence relays, as exemplified by the type shown in Figure 17, can be found in a variety of communications devices and associated equipment. In this type of relay, energizing the coil moves a pawl, engaging a ratchet which rotates cams to open or close the contacts. The contacts then remain in the same position until the

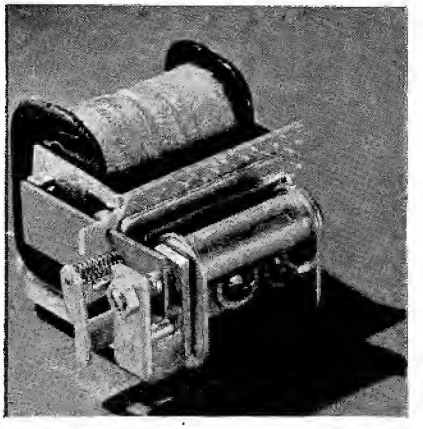


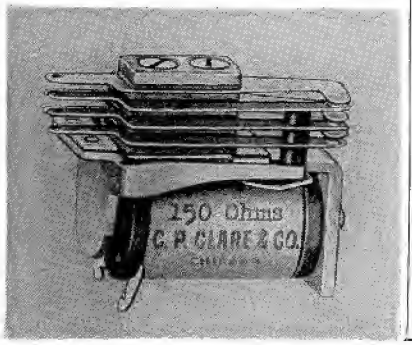
Figure 18
A General Controls sensitive type of relay.

coil is de-energized and again energized.

In mobile, aircraft and general communications practice, sensitive relays have become quite a predominant factor. When operated by the impression of r-f current on the tuned circuit, using a grid-glow tube and three element amplifier tube, these relays may serve to propel the operation of a radio-actuated air-raid blackout switch, burglar alarm, etc. In the typical model shown in Figure 18, a high sensitivity as low as 5 milliwatts is attained. It is shown as a bare relay, for adoption with other portions of the circuit. It is available in a suitable phenolic or steel casing as the requirements might be. Types are available with coil resistances ranging from .5 ohm to 10,000 ohms, and in single pole, single throw or single pole, double throw.

Midget relays for use in the compact type units, now so common, are being made in many styles and types. In Figure 19 appears a d-c type of midget relay, that is available with up to 12 springs, and a coil voltage range of from 1.5 to 60 d-c. The weights of all of these types of relays are naturally very low. In this model shown, for instance, the weight is only 1 2/3 ounces. And it occupies but 1½" x 1¼" x 13/16" of space.

Figure 19
A C. P. Clare midget relay that weighs but 1⅔ ounces.



THE ROCHESTER FALL MEETING

(*Continued from page* 34)

used. Lights are mounted across the top of a cable board with each light corresponding with one wire in the cable. Each operator has a different color light. Mr. Rice gave credit to Mr. Joel of Farnsworth Television for this method of testing.

Fly's Post-War Discussion

Our post-war effort was featured in a talk by James Lawrence Fly, chairman of the Federal Communications Commission and Board of War Communications. He said that after this war our radio machine will be plunging ahead at a far greater speed. This machine cannot be stopped nor permitted to slow down at that time, he continued. The energy required to make this readjustment will be a tremendous one, he explained. He thus suggested the consideration of the formation of committees to work on post-war problems, citing the NTSC as an example to follow.

The first step that these committeees can study would be the possibilities of plans for television and frequency modulation.

The second step that these committees should undertake would concern the distribution of the surplus of radio war equipment that will prevail. In addition, Mr. Fly pointed out, there will be new types which are the result of new developments and inventions. The disposal of this equipment, he said, certainly constitutes a major objective.

In the third step to be undertaken by these committees, Commissioner Fly told of the thousands of men and women with new skills gained in the Armed Forces that will have to find a place in radio. In addition, there are many wo-

(*Continued on page* 40)

THE ROCHESTER FALL MEETING

(*Continued from page 39*)

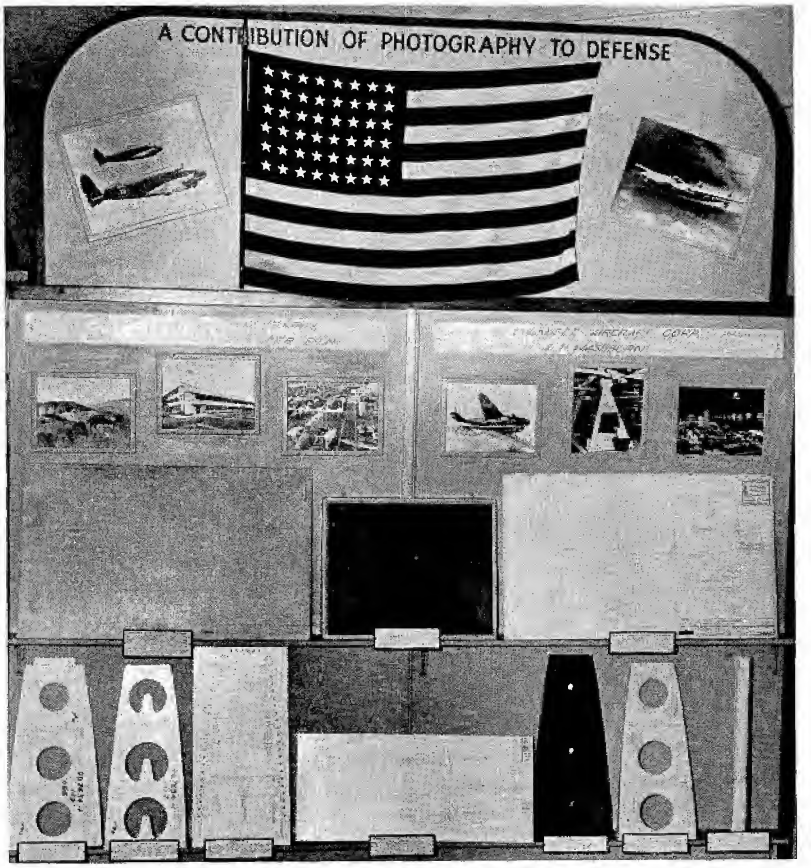
men who have absorbed skill in radio devoted to war production. It is certain, said Mr. Fly, that an appreciable proportion will want to continue in this line of work. Therefore, he added, employment for all of these people who most certainly will want to work in radio, must be thought about at the present time.

In the fourth and last step, Mr. Fly pointed out the many allied uses of radio and what they will mean in the post-war effort. We must begin thinking about the use of radio and communications in this new extended form now, he said.

The potential importance of international broadcasting must not be overlooked, either, said Mr. Fly. New methods and technics may be found in the broadcasting of sound and pictures to people in foreign lands to give visual and living emphasis common to people everywhere, explained Mr. Fly.

We must not forget television, either, he continued. The distance limitation that is now imposed upon television must be broken down. In the upper regions of the frequency spectrum we must prepare for expansion, explained Mr. Fly. It is virtually certain that it will be possible to take immediate possession of that portion between the present upper top of approximately 150 megacycles to at least 3,000 megacycles, he said.

In his address Mr. Fly also paid tribute to Dr. L. P. Wheeler, who now heads the engineering department's information division of the Federal Communications Commission, and who has just been elected president of the Institute of Radio Engineers for the coming year. E. K. Jett, chief engineer of the Federal Communications Commission, was also commended for his untiring efforts in aiding the communications industries in both their civilian and military obligations.



The use of photographic templates in duplicating intricate drawings and plans rapidly was discussed by E. J. Jewett of Eastman Kodak. Above are shown a few of the templates and drawings that are used in this interesting process.

TRAINING WITH THE CATHODE RAY

(*Continued from page* 20)

when both are applied separately to the vertical deflecting plates of the instrument.

Current measurements of any kind may be made by using the oscillograph to measure the voltage drop across a resistor in the circuit through which the current is flowing. If the resistance is known or measurable, Ohm's Law may be applied to determine the intensity of the current flow. Total space current for any vacuum tube may be thus ascertained by simply connecting the oscillograph which has been previously calibrated across the cathode resistor if automatic bias is used.

A complete check on the operation of receivers may be made using no other measuring instrument but the oscillograph. For example, a t-r-f receiver would offer the following possibilities: (1) Oscillograph connected across the grid cap of the first r-f amplifier and ground. This affords measurement of the r-f input to amplifier from antenna and tuned circuit. (2) Across cathode resistor of first r-f amplifier the unit measures d-c space current. (3) Placing it on the plate tap on r-f transformer we learn the r-f gain. (4) When placed on the cathode of detector tube, rectified r-f current data are available. (5) Audio input data is determined by placing the unit on the grid of first audio amplifier. (6) On the plate circuit of first audio the oscillograph reveals audio gain. (7) Repeat the foregoing procedure to check the audio power amplifier.

In the case of the superheterodyne, these measurements may be repeated and the following steps added: (1) The oscillator output voltage and current can be checked in similar manner as above. (2) The plate and grid circuits of i-f tubes can then be analyzed to secure i-f gain and alignment. (3) Since wave form indications are necessary for maximum fidelity adjustment, a signal generator (cw) can be fed into a time base wobbulator. The output of the latter can then be fed into the first tube of the i-f system and the output of the i-f system fed into the vertical deflecting plates via the cathode circuit of the second detector, or from the high side of the diode load resistor.

Transmitter Maintenance

With regard to transmitter maintenance, the oscillograph is also invaluable for the following checks and measurements: (1) Audio fidelity from the speech amplifiers and modulator. This same check is, of course, possible on all forms of public address equipment. (2) Percentage modulation . . . wave form or trapezoidal patterns. (3) Modulation distortion, positive and

(*Continued on page* 42)

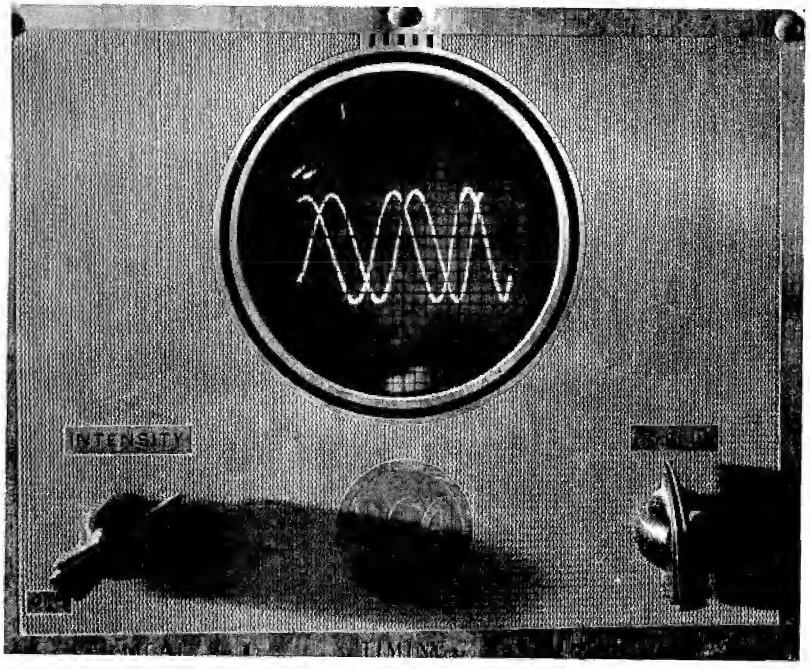


Figure 5

Cathode ray oscillograph when used in conjunction with an electron switch can indicate suspected phase shift in an amplifier, as illustrated here.

NEWS BRIEFS

(*Continued from page* 29)

and manpower in the relief, release and supplement of heavy machine tools, and details, with description and illustrations, many parts on which operations are done freehand or with simple, inexpensive fixtures.

A copy will be gladly sent upon request, without cost.

* * *

AMERICAN RADIO HARDWARE ON TREASURY HONOR ROLL

The American Radio Hardware Company, 476 Broadway, New York City, has been advised that they are on the Treasury Department Honor Roll for having attained the 10% of gross payroll goal in their Payroll Savings Plan.

D. T. Mitchel, president of American Radio Hardware, reports that both the factory workers and the executive staff are now contributing not only the 10%, but considerably more in the drive for War Bond purchases.

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THE INDUSTRY OFFERS . . .—

(*Continued from page* 36)

ploys an 11-pin base, and can be operated with higher anode voltages. The 5R4-GY is a coated-filament type having a maximum peak inverse voltage rating of 2800 volts, a peak plate current rating of 650 milliamperes, and a maximum d-c output current rating of 175 milliamperes when a choke-input type of filter is used. It has a micanol base.

The 6AG5 has a sharp cut-off characteristic and a high value of transconductance. Having miniature construction, the 6AG5 is useful in compact, light-weight equipment as an r-f amplifier up to about 400 megacycles, and as a high-frequency intermediate amplifier. It has low input and low output capacitance. The 6J6 has two grids and two plates with a common cathode indirectly heated. The twin units may be operated in parallel or in push-pull. with push-pull arrangement of the grids, and with the plates in parallel, the 6J6 is particularly useful as a mixer at frequen-

(*Continued on page* 47)

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TRAINING WITH THE CATHODE RAY

(*Continued from page* 41)

negative carrier shift, over-modulation, under-modulation, incorrect bias, incorrect excitation. The patterns to be expected from incorrect operation of transmitters may be found in any handbook on radio operating or engineering. It should be noted, in this connection, that each student in such a maintenance course must be allowed to handle the oscillograph and adjust it frequently in order to "get the feel" of the controls. It is advisable to check by ear when oscillograph tests are being run to determine whether the ear is sensitive enough to show up the defects brought out by the former.

VWOA NEWS

(*Continued from page* 30)

Memorial Scroll to Mr. Helmbold for outstanding heroism as Radio Officer aboard the Bull Line freighter Lillian several years ago. . . . It is with deep regret that we learn of the recent death of Mrs. Baarslag, mother of Karl Baarslag, author of several books, most notable of which is "SOS to the Rescue." Our sincere condolences to Karl now serving as a Lieutenant in the United States Navy in Washington.

•

REMINISCING WITH BILL FITSPATRICK

SOME of our members who are "down under" in far-off Australia may find it hard to re-orient themselves when they come back to the United States, because of the difference in customs between here and there. Australians travel north when they go to the tropics; they take their vacations around Christmas time instead of in July or August—perhaps the word should have been "took"! They start to work on Wednesday morning before Bill McGonigle leaves his New York office on Tuesday night—provided he isn't "off duty" on that day. They don't see the "man in the moon" because the moon is upside-down to them. When they are "on holiday" they go to the beaches and indulge in "surfing." And if any of them sent in stories of the past to your Secretary, as requested in last month's issue of COMMUNICATIONS, they haven't arrived yet!

Commander Pierre Boucheron and Lieutenant Commander Steve Wallis passed through New York recently, en route from X to Y. Pete says he enjoyed his last tour of duty, wherever it was, and Steve insists that when he gets to his destination he will form a new chapter of VWOA, when he learns the language, if any.

Ray Guy, old-timer of NBC and us, joined the Army as radio operator during the last war, and never saw a radio set during his entire term of duty. He was billetted in so many stables that he won't mind it a bit if we have to eat straw instead of meat any day soon. His saddest experience, however, was being stuck in a landslide in Costa Rica, subsisting for days on canned crackers and Pina Frias. Those who know what the latter delicacy consists of will appreciate our delicacy in not spelling it as "daze."

Still active in veteran wireless activities in San Francisco is Arthur Isbell, RCAC, Ret. He was the first commercial wireless operator on the Pacific

(*Continued on page* 44)

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933, OF COMMUNICATIONS

Published monthly at New York, N. Y., for October 1, 1942.
County of New York, } ss.:
State of New York, }

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared B. S. Davis, who, having been duly sworn according to law, deposes and says that he is the Business Manager of COMMUNICATIONS, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Bryan Davis Publishing Co., Inc., 19 East 47th Street, New York, N. Y.; Editor, Lewis Winner, New York, N. Y.; Managing Editor, None. Business Manager, B. S. Davis, Ghent. N. Y.; 2. That the owners are: Bryan Davis Publishing Co., Inc., 19 E. 47th St., New York, N. Y.; B. S. Davis, Ghent, N. Y.; J. C. Munn, Union City, Pa.; A. B. Goodenough, Port Chester, N. Y.; P. S. Weil, Great Neck, L. I., N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1% or more of the total amount of bonds, mortgages, or other securities are: None. 4. That the two paragraphs next above, giving the names of the owners, stockholders. and security holders. if any. contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also, that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) B. S. DAVIS, Business Manager.

Sworn to and subscribed before me this 30th day of September, 1942.
(Seal) FRANKLIN B. GOOLD, Notary Public.
Commision expires March, 1944.

VWOA NEWS

(*Continued from page* 43)

Coast, arriving there from Camden around the Horn to San Francisco on the first vessel to make this trip with "wireless." It took him forty-nine days to make the trip, which perhaps explains why he hasn't been back East to see his friends since his retirement. He was the first to open radio communication between the Hawaiian Islands and the mainland, and was the first to erect a wireless station in New Zealand. No wonder he is taking it easy these days!

•

ELECTION NEWS

FROM our Constitution, Article II, Section 2, Constitution and By-Laws, V. W. O. A., Inc. . . . At the December meeting the board of directors shall submit a list of nominees for officers and board of directors, of not more than three names for each office, president, vice-president, secretary and treasurer, and not more than twenty names for board of directors. Printed ballots shall be prepared and mailed to each member eligible to vote. These ballots shall be returned to the secretary sealed, not later than midnight prior to the day of the January meeting.

Article III, Section 1; Nominations and Election of Officers and Board of Directors. . . . Following the November meeting the board of directors will receive petitions in writing, signed by not less than thirty members entitled to vote, setting forth the name of the candidate and the office for which it is desired he be nominated. These petitions shall be considered by the board of directors

(*Continued on page* 47)

U-H-F TEST OSCILLATOR

(*Continued from page 7*)

nant circuit L2-C3 in the plate of 1b is tuned to the third harmonic. C6 constitutes the plate by-pass.

Final Amplifier

The drive for the final amplifier stage, using one section of the 6N7 tube designated 2a, is obtained through the coupling condenser C7 and the resistors, R8/4. The plate circuit consisting of C4 and L3 is tuned to the sixth harmonic. C8 is the plate by-pass condenser in this circuit. The "B" supply to the final is adjusted by use of R5. The antenna is fed by the coupling unit consisting of L4 and L3.

Modulator

The modulator triode is the 6N7 section designated 2b. The primary of the transformer T1 using condenser C15 forms a conventional a-f oscillator circuit including the elements C9-R11, C10-R12, C11-R13, which are adjusted to tune the a-f oscillator to 3000, 1300, 400 cps respectively. The switches S2 and S3 permit automatic or manual selection of the modulation frequencies, while the latter permits continuous operation on any one of the three. Transformer T1 secondary provides coupling to grid modulate the final.

Power Pack

The nominal 12-volt input circuit includes an "ON-OFF" switch S1 and a fuse F1. As indicated previously, this circuit connects power to the tube filaments and the vibrator power pack. The vibrator (VIB) is a synchronous type associated with the transformer T2 and the "contact-spark" filters C20-R14 and R15-C21, in the conventional manner. A 1:1 ratio transformer T3 supplies a-c to the motor that is used to drive the a-f automatic selector.

Metering Circuit

Resistors R17, R10, R6, R7, and R9, values are proportioned to indicate on the meter, as selected by the meter switch, the circuit voltages of oscillator plate, amplifier plate, final plate, final grid, and modulator plate.

The writer wishes to acknowledge the valued work by L. C. Bishop, A. P. Stuhram and F. R. Swearingen of Eastern Air Lines and G. E. Smith of Communications Co. for their co-operation in solving many of the problems involved in the development of this unit.

[This is the third of a series of articles covering an analyses of aircraft communication equipment and components. Serving as an advisory editor for this series is Frank Melville, world-famous transatlantic aircraft communications expert, and president of the Melville Aeronautical Radio School.]

ALERT SYSTEM

(*Continued from page 22*)

the alarm until the tone has passed through the equipment for an allotted period. In view of this precaution, the alarm circuit will not operate the alarm bell that might originate from ordinary circuits, but only from the circuit originating at the key interceptor point.

Time Delay Circuit

The time-delay relay circuit is of the motor driven type, thus eliminating any possibility of failure due to tube failure. In addition, this type of time delay can be adjusted to any cycle desired from one second to sixty seconds.

Carrier Cut-Off Alarm

A carrier cut-off alarm, also a requisite of a suitable alarm system, has also been included in this interceptor service. This calls for the sensitive relay to hold up all the time the carrier is on. But if the carrier or power fails, the relay is released, and the alarm is operated through a set of batteries.

The principle of operation of the carrier-off alarm involves the use of a radio receiver employing a beat oscillator. The beat oscillator must be tuned to a frequency identical to that of the carrier-off alarm. In other words, the carrier-off alarm frequency is peaked to the beat oscillator frequency. Thus the beat oscillator beats against the carrier of the key station at this frequency, and with this tone going through the carrier-off alarm, the sensitive relay holds up. If the carrier fails, of course, the beat stops, releasing the relay and prompts the ringing of the bell.

Where, of course, the key station is some distance from the receiving point, fading may operate the alarm bell. However, this is a peculiarity that cannot be avoided, since the absence of the carrier provides the very basis of operation. In view of this problem, key stations may be so plotted to avoid any possibility of this error factor occuring.

Construction

The alarm unit is built on a seven by nineteen inch panel, that can be mounted in any standard relay rack. In the first amplifier a 6J7 is used. A 6C5 serves as the interceptor cut-off tube. The complete unit is self-contained, requiring only a small receiver to complete its operation. The master gain, level test jack, pilot light, and a-c toggle switch occupy the front panel positions.

Front view of the alert device, showing the alarm bell in center.

WHEN YOU CHANGE YOUR ADDRESS

Be sure to notify the Subscription Department of COMMUNICATIONS at 19 E. Forty-seventh St., New York City, giving the old as well as the new address, and do this at least four weeks in advance. The Post Office Department does not forward magazines unless you pay additional postage, and we cannot duplicate copies mailed to the old address. We ask your cooperation.

VWOA NEWS

(*Continued from page* 44)

and shall be included in the final list of nominees when submitted at the December meeting:

The present officers are: William J. McGonigle, president; A. J. Costigan, vice-president; George H. Clark, secretary; William C. Simon, treasurer. Directors are: George H. Clark, A. J. Costigan, W. S. Fitzpatrick, William J. McGonigle, Fred Muller, H. H. Parker, C. D. Guthrie and V. P. Villandre.

REMEMBER . . . We will have simultaneous Dinner-Cruises of our various chapters on the evening of February 11, 1943. See you then!

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THE INDUSTRY OFFERS...—

(*Continued from page* 42)

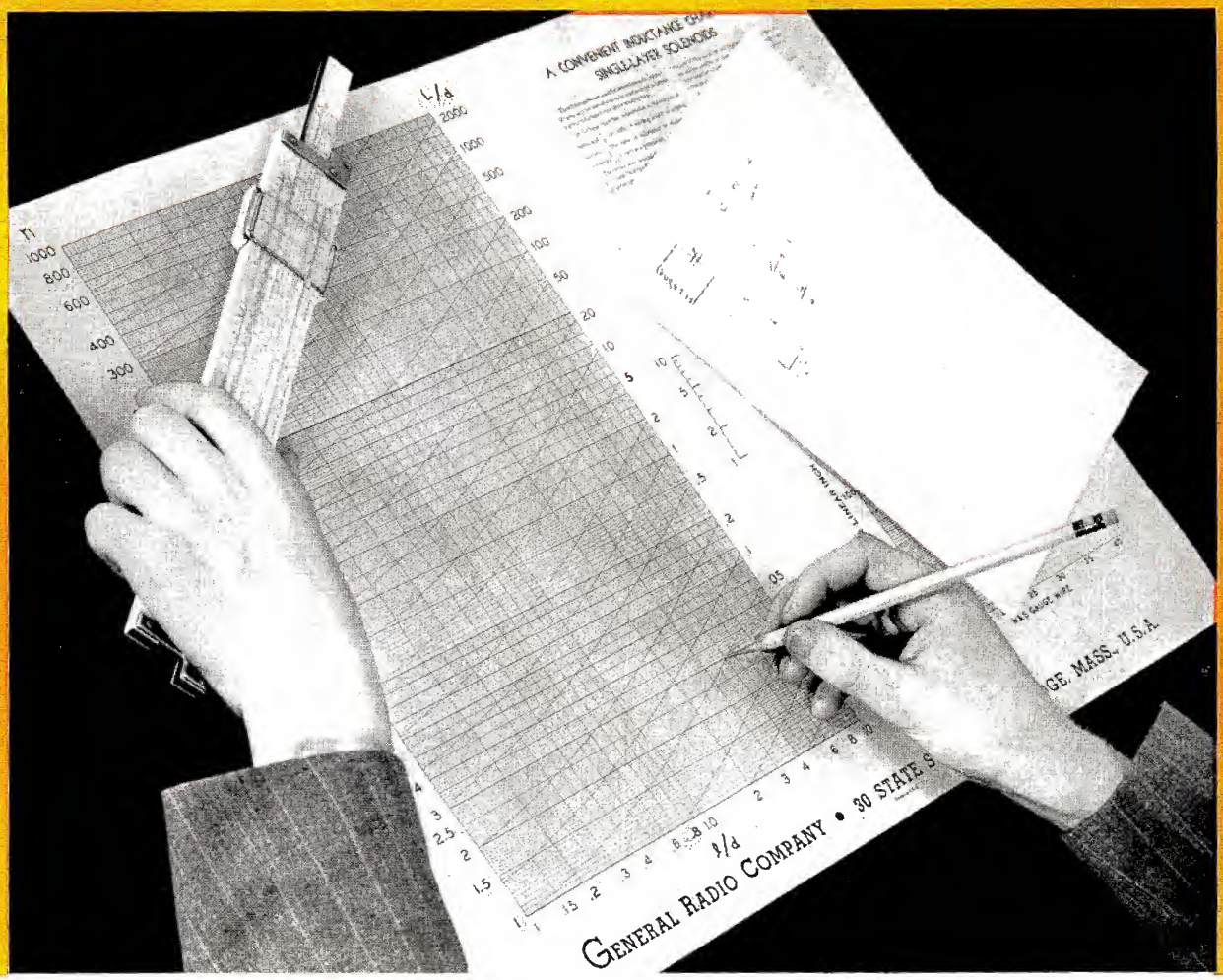
cies as high as 600 megacycles. It is also useful as an oscillator.

LECTROHM SOLDER POTS

Small capacity Solder Pots are being manufactured by Lectrohm, Inc., 5125 W. 25th Street, Cicero, Illinois, for continuous operation in radio, motor and similar electrical equipment plants where individual soldering melting pots are desired for each operator or for small repair and homecraft shops. They consist of a cast iron pot mounted, by a single screw, on a plated steel stand. A single heat, porcelain nickel-chrome heating element, which can be replaced, heats the pot.

These pots are available in two models (No. 200, 1¾ pounds capacity, and No. 250, 2-pound capacity).

Index to Advertisers



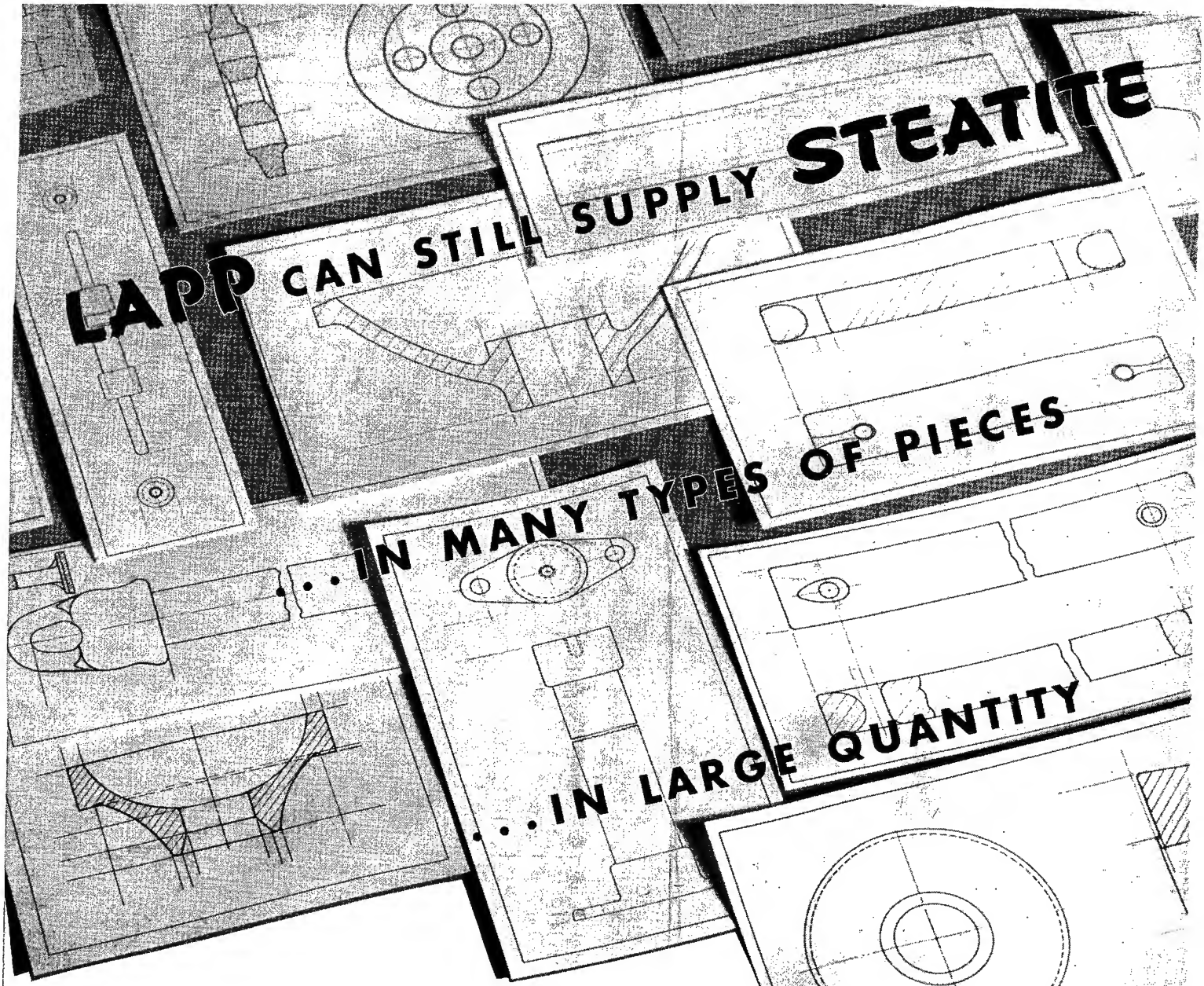
This Chart Saves Time . . .

Designing inductors for use at radio frequencies takes time. Even when accurate formulae are available, computing inductance may be tedious. Practically every radio engineer has to design inductors occasionally; many design them continually.

To save time in our own laboratories, we have devised a design chart for single layer coils which gives results to very good accuracy. It is entitled "A Convenient Inductance Chart for Single-Layer Solenoids," and is 18" x 22" overall, suitable for wall mounting. It is used for determining the number of turns and the size of wire to be used in order to obtain a given inductance on a given winding form. The explanation includes an example.

A number of these charts are available for our friends. If you can use a copy, we shall be glad to send it on request. Ask for Inductance Chart No. 810.

GENERAL RADIO COMPANY · Cambridge, Massachusetts



As a leading manufacturer of high-voltage insulators and porcelain pieces, Lapp facilities are adequate for production of high-quality ceramics in large tonnages. The development of Steatite production techniques was undertaken aggressively by Lapp more than four years ago. Shrinkage, glazing and firing problems peculiar to Steatite have been solved. Electrical characteristics are assured by complete testing facilities including a high-voltage radio frequency generator. For production of Steatite pieces for which Lapp processes are suitable, Lapp offers almost unlimited capacity. *Don't be misled by talk of a Steatite shortage until you find if Lapp can make the pieces you need.*

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